An Analysis of Grid-Based Digitized and Intelligent Teaching System for Vocational Education Resources in Minority Regions

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Abstract. Restricted by many factor, it is difficult for minority regions to acquire the quality and abundant educational resources equivalent to what economically developed regions can have. This has significantly hindered the development of vocational education in minority regions. A digitized and intelligent teaching system was established. The system adopts a multi-layer architecture, and comprises the interaction layer, the content layer, the service layer and the data layer. It covers two sub-systems, namely the curriculum resources and the teaching resources, and opens up diversified teaching channels for the vocational education in minority regions. Through systematic simulation and test, the learning situations, the teaching results and the attention rates were compared and contrasted between the traditional teaching model and the digitized and intelligent teaching system for vocational education resources in minority regions, so as to analyze the rationality and necessity of the design on this teaching system.

Keywords: Minority regions · vocational education resources · grid-based mode and teaching system

1 Introduction

The good educational resources work as an important factor for China to realize the comprehensive and high-quality development in education, to promote the education modernization and construct an equalized and quality talent cultivation atmosphere. Restricted by many social factors, such as geographical location, regional economic foundation and industrial development, it is difficult for minority regions to acquire the quality and abundant educational resources equivalent to those in economically developed regions. Vocational education serves as a key measure for China to consolidate the achievements in poverty eradication and facilitate the rural revitalization. Vocational education sets a higher demand for teaching conditions than common education so the deficiencies in educational resources have seriously hindered the development in vocational education in minority regions. The advent of the digitized and intelligent era has laid environmental foundation and technical substrate for educational reform. The establishment of a grid-type digitized and intelligent teaching system for vocational educational resources in minority regions serves as an effective approach for those regions

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to share quality vocational educational resources. This initiative can broaden the path for education equity, bring forth new ideas to talent cultivation models, teaching methods and teaching channels, and create an ecological education environment for undifferentiated sharing of quality educational resources. Furthermore, it can narrow the regional gap in vocational educational resources and realize the organic integration of large-scale and individualized national education.

2 The Framework of the Digitized and Intelligent System for Vocational Education Resources in Minority Regions

The digitized and intelligent system adopts a multi-layer architecture that consists of interaction layer, content layer, service layer and data layer, as shown in Fig. 1 [1].

Interaction layer involves the users with different permissions, such as teachers, students, administrators and visitors, and their functions [2].

Content layer provides users with teaching resource module navigation. Users can only log into the navigation page through identity authentication. Permissions for access to teaching resource module vary upon user type.

Service layer comprises teaching function layer and teaching administration layer. Teaching function layer forms an important part of the system, including the intelligent learning assessment test, the sharing and allocation of teaching resource, the differentiated learning content pushing, the intelligent supervision over learning process, the course forecast and notification, the curriculum forum, the real-time interaction between teachers and students, the mutual evaluation between teachers and students, the assessment and other modules. Via this teaching function layer, users can formulate personalized learning plans, exchange and answer questions, share and create educational

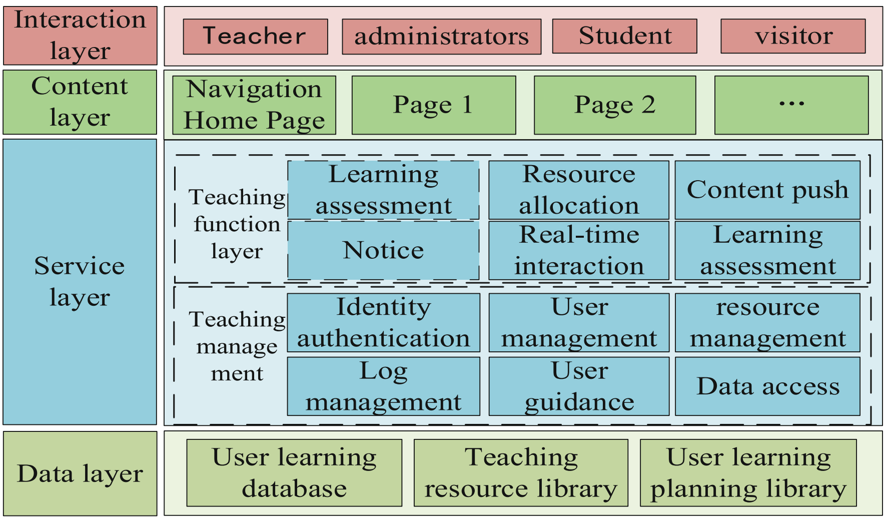

Fig. 1. The Framework Diagram on the Digitized and Intelligent System for Vocational Education Resources in Minority Regions (Self-drawn)

resources, and evaluate teaching result and quality in multiple manners, etc. [3]. Teaching administration layer mainly provides user identity authentication, user administration, teaching resource management, information screening, log administration, intelligent user guidance, data access and other public service modules. This layer can manage user information and study logs, guide and help users to orient their learning in real time, push personalized teaching contents and learning plans to users based on their learning habits and demands, manage teaching resources, and upload and download resources and data.

Data layer is composed of user learning database, teaching resource library and user learning planning library. It is designed to save all of the data received and generated by teaching system [4].

3 The Functions of the Digitized and Intelligent System for Vocational Education Resources in Minority Regions

A society-oriented open immersive grid-type digitized and intelligent system was constructed for vocational education resources across schools and districts in minority regions [5]. This teaching system takes "supporting the development and maintaining the economic prosperity in minority regions and inheriting and bringing forth new ideas to minority cultures" at its core [6]. Rooted in the economic and social development demands in minority regions, the system closely follows the development trends in emerging industries and keeps alignment with the operation, management and production standards in those industries. It consists of curriculum resource subsystem and teaching resource subsystem.

3.1 Curriculum Resource Subsystem

The curriculum resource module was built based on the standardized training objectives for applied talents in enterprises and industries in order to break the teaching form and course design logic of traditional course division. The curriculum of vocational education science was divided into several grid-based knowledge themes; the knowledge, skill, vocational competence and social capability involved in occupations and positions were incorporated into each grid-based knowledge themes. Each knowledge theme was established with specific teaching objectives and syllabuses. Those knowledge themes were arranged in accordance with the internal logic of knowledge system so as to create spiral progressive learning tasks and practical work tasks for students. Those grid-based knowledge themes were presented to students in the form of a visualized "grid tree" so that students could clearly see the connection among those themes. When students log into the platform for the first time, it will analyze their existing knowledge foundation by multi-dimensional questionnaire survey, understand their learning demands and habits, and then intelligently recommend personalized learning plans. Then, students choose and learn grid-based knowledge themes flexibly and control the learning process independently. The system monitors their learning situation intelligently, and then provides them with timely one-to-one on-line tutorship in case of any learning difficulty.

The curriculum resource subsystem is sub-divided into the theoretical curriculum resource sector and the practical training curriculum resource sector [7]. The theoretical teaching sector takes grid-type knowledge theme as unit, and comprises teaching contents, lesson plans, course-ware, teaching videos, 3D animation, knowledge expansion, exercises, tests, and other resources; the practical teaching sector creates an authentic work environment for students, where a learning process is the practical problem-solving process [8]. In the practical training course, student-centered experiential teaching is conducted to create spiral progressive learning tasks and practical work problems for students. Practical teaching is established on authentic work scenes and consists of several multi-dimensional task modules. One task module covers several vocational skill grids; each grid comprises practical training configuration, practical training instruction, operation process, operation demonstration, virtual interaction, authentic work scene, assessment standards, etc. Students choose their task modules under the intelligent guidance by the system based on their competences and career development demands. By solving those problems, students seek, distinguish, screen, master and apply knowledge and skills, and thus develop their self-reflection abilities during the process of completion [9].

3.2 Teaching Resource Subsystem

Teaching resource system includes digitized and intelligent lesson preparation subsystem, teaching interaction subsystem and teaching evaluation subsystem. Digitized and intelligent lesson preparation subsystem covers lesson plans, course-ware, teaching materials, teaching method design, teaching records of prestige teachers, exercise database, interactive communication, etc. [10]. The subsystem can provide teachers with various teaching functions, such as grid-based knowledge theme context presentation, digitized and intelligent lesson preparation resources, intelligent teaching material editing, menu-type lesson plan and course-ware formulation, automatic generation of on-line curriculum. It can provide the materials for lesson preparation intelligently according to teachers' curriculum framework, and reduce the workload for teachers to collect teaching resources and formulate lesson plan and course-ware. In this way, it effectively promotes the lesson preparation efficiency and expands more space for teachers to consider curriculum innovation and teaching reform. By virtue of the interactive communication function, teachers in the same course can prepare lessons, exchange their thoughts and ideas, and share teaching methods together across schools and districts, thus bringing forth new ideas to their teaching strategies and promoting their teaching abilities in the collision of their educational philosophies.

Teaching interaction subsystem connects the teachers' teaching end and the students' learning end through hardware and software. The subsystem can realize the real-time intelligent recording and broadcasting of the whole teaching process, and comprehensively record the demonstration, manipulation, writing and other procedures by teachers in their teaching process. It can analyze students' learning process and understanding of key and difficult knowledge points intelligently, form the reports on students' real-time learning situation, and then display them to teachers in a visualized and concise manner. Those functions facilitate teachers to adjust their teaching strategies based upon their understanding of students' immediate learning situation. Teachers select appropriate learning contents, exercises and tests according to students' learning ability and progress, and then present them to students in a customized manner that fits in well with their different learning habits and abilities, so as to conduct targeted and differentiated teaching activities.

Teaching evaluation subsystem comprehensively collects the data on students' learning, such as their current learning situations, learning attitudes, professional competences, core social capacities, exercise and test results, course discussion participation and attendance, evaluates students' learning situation in all-round way through scientific and multi-dimensional evaluation system, and gives regular feedback to teachers, so as to provide teachers with the bases for teaching reform.

4 Simulation Test

Simulation test was adopted herein to compare and contrast the learning situations and teaching results between the traditional teaching mode and the digitized and intelligent system for vocational education resources in minority regions, and then to analyze the rationality and necessity for such a systematic design. The basic data of users are shown in Table 1.

According to the above table, as student number increases, the "comprehensive course performance", "competition participation rate" and "chapter review times by each student" in the traditional classroom teaching present a downward trend; among them, "comprehensive course performance" and "competition participation rate" see a obvious decrement with the increase in student number. After adopting the digitized and intelligent teaching system for vocational education resources in minority regions, the "comprehensive course performance", "competition participation rate" and "chapter

Table 1. Analytical table on teaching (Self-drawn)

Class size	Traditional classroom teaching			Teaching via the digitized and intelligent system for vocational education resources in minority regions		
	Comprehensive course performance in average	Competition participation rate	Chapter review times by each students	Comprehensive course grade in average	Competition participation rate	Chapter review times by each students
50	82	60%	28	88	60.6%	157
100	79	50.2%	28	87	60.3%	157
150	75	39.6%	26	87	59.1%	153
200	72	31.7%	22	86	58.4%	155
250	68	30.1%	20	86	57.7%	155
300	63	24.9%	20	86	56.5%	152

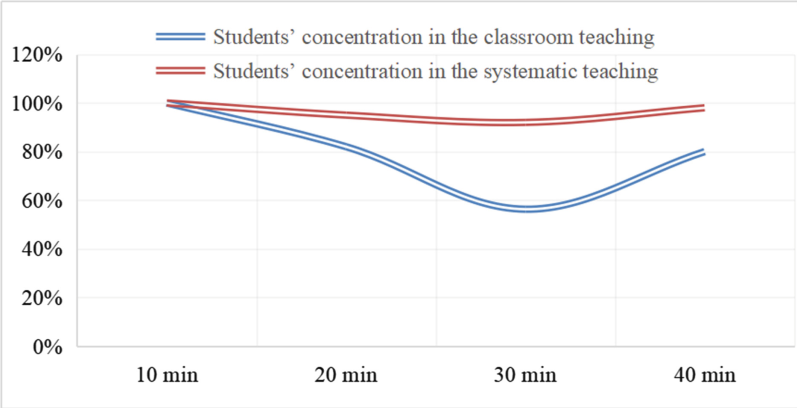

Fig. 2. Comparison Diagram on Students' Concentration (Self-drawn)

review times by each student" are subject to less influence from student number, and see no significant change with the increase in student number and less restriction by teacher-student ratio. All of the students can receive appropriate individualized teaching. They can strengthen the repeated learning against their weak knowledge and skill according to individual needs; their comprehensive performance and enthusiasm for participating in competitions are higher than those in the traditional classroom teaching. To sum up, compared with the traditional classroom teaching, the digitized and intelligent teaching system for vocational education resources in minority regions has more advantages in teaching result, students' learning enthusiasm, students' learning interest, etc.

Through the teaching monitoring system in the classroom and the digitized and intelligent teaching system for vocational education resources in minority regions, the student faces during their learning processes were detected intelligently for concentration rate calculation. Thus, a comparison diagram was generated in terms of students' concentration rates between the traditional classroom teaching and the digitized and intelligent teaching system for vocational education resources in minority regions, As shown in Fig. 2. According to the diagram, this digitized and intelligent teaching system is more attractive to students than the tradition classroom teaching. During the 40-min learning period, the system can sustain a high concentration rate among students and thus achieve a better teaching result.

The simulation test shows that the digitized and intelligent teaching system for vocational education resources in minority regions can meet the teaching demands of teachers and the learning demands of students better so it deserves a wide promotion and adoption in the vocational education circle.

5 Conclusions

The advent of digitized and intelligent era has provided strong technical support for the innovation and change in education. The digitized and intelligent teaching system breaks the temporal and spatial barriers, creates a digitized and intelligent teaching environment, and shares quality teaching resources across schools and districts. Thus, it creates the abundant and diverse learning materials and an intuitive and in-depth immersive learning space for students, and provides teachers with quality and efficient lesson preparation and teaching approaches, so as to shorten the education gap among different regions. The system can develop a deeper understanding of users, dissect their preferences and needs intelligently and accurately, and recommend and customize teaching contents for them through collecting and analyzing the data from their using this teaching system, so as to meet their diversified learning and work needs. According to the analysis on users' utilization situations and in view of the demands from industrial talents, the digitized and intelligent teaching system keeps iterating and updating its functions and thereby becomes a strong impetus for the development in vocational education.

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