The Construction of an Occupation Competency Oriented Intelligent Education Dynamic Assessment Platform

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ABSTRACT
Inspired by the Industry Competency Model and the O*NET, this article reviewed the development process of occupation competency assessment in China, analyzed survey results of 83 teachers and 120 students, and found out that the existing assessment system is not open, informative, intelligent, and dynamic enough. Therefore, a new model of Occupation Oriented Intelligent Education Dynamic Assessment Platform is constructed here, equipping with big data, information assessment approaches, the dominance of enterprises, and multi-diversified participation, to solve the problems of different development subjects, uneven quality, and urgent need for improvement. This platform contains four main modules including Social Demand Assessment System, Education and Teaching Process Assessment System, Talent Cultivation Quality Assessment System, and Intelligent Person-Position Matching System, to make assessment concerning study behavior, occupation competency, and occupation performance.

Keywords: *Intelligent Education, Dynamic Assessment, Occupation Competency*

1. INTRODUCTION

Informatization and intelligence are the landmark features of the construction of the modern vocational education system. Building a dynamic and intelligent education environment is a major task in the modernization process of vocational education. Intelligent education is a new education form and mode with features including U-learning, integration, contextualization, individuality, and intelligence under the guidance of modern education theory and in the context of the new generation of information technology, which link the education managers, teachers, students, parents, and other social participants together to realize intelligent learning, intelligent teaching, intelligent management and more[1][2]. Intelligent education is the trend of educational informatization development and the main form of education in the future [3].

Teaching assessment is a vital measure to evaluate, supervise, guarantee and improve teaching quality, and is an essential part of the higher education quality assurance system. Under the ecology of intelligent education, the construction of a dynamic assessment platform for intelligent education aiming at teaching quality assurance is an important subsystem of intelligence and information management construction in colleges and universities.

The intelligent education dynamic assessment system makes full use of modern information technology to connect the internal campus information management system with the external industry and occupation information network and integrate the internal quality assurance system with visualized results as well as form a professional dynamic coordination mechanism for interacting with industrial chains to realize full integration between industrial chains and talents cultivation.

Through the construction of an intelligent information management platform, a system with the function of process management, quality dynamic monitoring, and assessment will be constructed to serve the talents cultivation quality and work performance assessment, list out the pieces of evidence and facts as the reference for decision-making of management, monitor and guarantee the elements of the steps that influence the teaching quality, set up the indicator to evaluate the process and the results of teaching. The timely feedback of the data can generate Student Progress Analysis Report (including Mind, Study,

Occupation)for students, Teacher Development Analysis Report for teachers, Teaching Quality Data Analysis Report for educational management, Occupational Performance and Competence Report for graduates to assist higher educational institutes in steadily deepening education and teaching reform, continuously optimizing education and teaching models, and unceasingly improving the quality of personnel training.

2. A REVIEW OF OCCUPATION COMPETENCY ORIENTED ASSESSMENT MODEL

In 1992, the Department of Education and the Department of Labor in the United States started to develop the National Skills Standard System, gradually integrated the different skills standards of various industries in various states, and promoted the unification of training objectives, curriculum planning, and qualification certification. Finally, a functional model framework was established, combining the Industry Competency Model with the O*NET (Occupational Information Network)[4].

2.1. Industry Competency Model in the USA

Industry Competency Model is built on 9 tiers. Tiers1-3 represent the foundational skills including personal effectiveness competencies(tier 1), academic competencies(tier 2), and workplace competencies(tier 3). Tiers 4-5 are industry-related competencies including industry-wide technical competencies(tier 4) and industry-sector technical competencies(tier 5) which are specified by the industry or industry sector representatives. Occupation-related competencies are formed by the management competencies and occupation-specific requirements[5].

This model embodies the characteristics of multi-agent participation. The American Industrial Competency Model developed jointly with the industrial associations, is an open system for industry workers, educators, economic development sectors, and public labor investment experts, and serves as the basis for curriculum development and competency certification.

This model constructs an occupation-oriented dynamic system. Industrial Competency Model, together with the O*NET, is accessible to the data of occupation competencies, which fully takes advantage of various questionnaires of occupation analysis (such as PAQ CMQ, etc.). It combines the analysis of occupation information with the worker’s characteristics and takes the organizational context and the working occasions into consideration to reflect the specific requirements of a certain position.

2.2. Occupation Competency Assessment in China

China started the occupation qualification system in 1994. And soon later the launch, problems, such as the excessive issue of occupation qualification certificates, gradually came into being. In 2013, China carried out a package plan to reform the already inapplicable mechanism and canceled approximately 70% of the qualification certificate in different kinds. In 2019, the Ministry of Education of China together with other departments jointly issued the Pilot Scheme for Implementing the System of Academic Certificate + Several Vocational Skill Certificates in colleges and universities and officially launched the pilot work of the 1+X Certificate system to certify, accumulate and convert the learning results reflected in the academic certificate and vocational skill certificates[6].

2.2.1. Industry-Oriented Occupation Skills Rating Mechanism

This is a major reform of China's vocational education system. The ‘1+X’ certificate system connects the professional skill level standard with the professional teaching standard, and the skill assessment and course examination are evaluated as a whole, which requires the vocational education teaching management and talent cultivation quality assessment to make significant reform. In 2020, the Executive Meeting of the State Council decided to carry out socialized skill level identification, establish an assessment mechanism that is more in line with the needs of the market economy system, and promote employers and social training and assessment organizations to implement vocational skill level identification services instead of the government[7].

In terms of assessment methods, enterprises are fully endowed with independent decision-making rights. Enterprises can choose a variety of assessment methods, such as process assessment, result appraisal, performance assessment, skill competition, school-enterprise cooperation, and so on.

2.2.2. Imperfect Occupation Competency Standard System

At present, China's occupation competency standards system has not been perfected yet with the features of different development subjects, uneven quality, and urgent need for improvement in the occupation competency standards recognition. Many vocational colleges have also begun to develop occupation competency assessment informative supporting tools. However, some of these tools are lack of theoretical basis.

Felix Rauner, Zhao Zhiqun together compiled and later published the Occupation Competency and Assessment - KOMET Theoretical Foundation and Scheme[8], which then received the support from the Ministry of Human Resources and the Ministry of Social Security in China and later developed into COMET Occupation Competency Assessment Standards, and further into COMET Occupation Competency Assessment Management System by relevant personnel. There are three competency levels, eight competency indicators, and forty assessment points. It records, manages, calculates, and analyzes the relevant data in the process of occupation competency assessment and generates the competency skeleton map for individual students or particular groups. Users' (both students and teachers) information, student questionnaire survey, examination, and other relevant data are all employed here for the system's data analysis and management.

Background questionnaires and test questions are frequently used assessment methods in the past. The teaching quality assessment mechanism has been established for many years in China's colleges and universities. However, the data has not been used effectively, and teachers and students have a negative attitude towards the assessment.

In order to find out the existing problems and providing countermeasures. An online questionnaire was designed to survey both students' and teachers' thoughts about current assessment system. More than 120 students from 7 vocational colleges participated in this survey. According to the survey we conducted, top 3 major problems in the assessment system commonly raised by teachers and students are listed below:

a, the system is designed with absolute standards and lacks pertinence and a scientific foundation. The one-time assessment at the end of the term also means that the assessment data lacks timely feedback and cannot be applied to the improvement of the teaching process;

b, compulsory assessment requirement causes a rebellious attitude. It is a blow to the students' enthusiasm and reduces the reliability and validity of the data as well.

c, current adopted technology can not support efficient and effective data analysis to get timely and effective feedback. It fails to promote the in-depth interaction between teachers and students

Meanwhile, field survey of 83 teachers helps us to know the existing problems in the teaching quality assessment systems. The survey results are as follows:

Options	Ratio
Results are only accessible at the end of the semester. Teachers cannot get feedback and make the timely adjustment.	99%
Standards are too simple to be taken as references to change teaching methods.	95%
The current adopted technology can not support efficient and effective data analysis.	68%
Malicious and retaliatory assessments exist.	54%
Assessment does not receive much attention.	46%

Figure 1. Teachers' attitudes towards current teaching quality assessment

COMET Occupation Competency Assessment, based on the typical work tasks, replacing situational question and answer with open tasks, taking analysis, planning, decision-making, implementation, record, display, and assessment during the task completion process as a focal point of testing and assessment, has reflected the concept of occupation-oriented education to a great extent. However, this system has neither included the data of students' learning behavior and progress process into the analysis framework nor has it connected with the external information network and resource network to dynamic assessment and feedback on students' occupation competency from the demand side.

In general, the existing occupation competency assessment model has the features of government-leaded, implementation through colleges and universities, and insufficient participation of industries as the third party. The assessment focuses on internal education and teaching, especially the assessment and diagnosis of the effect of talent cultivation and the quality of education. For individual students, it is mainly based on the skill certificate obtaining rate, skill competition awards, employment matching rate, and some other indicators.

The existing assessment method is not open, informative, intelligent, and dynamic enough. Therefore, supported by the modern vocational education concept, oriented by tasks and career development, dominated by the government and under its supervision, a new model of intelligent dynamic assessment system is designed to improve the adaptability of the modern technical and vocational education reform governance paradigm. This system makes full use of intelligent technology to make a systematic procedural dynamic assessment of study behavior, study performance, occupation competency, talent cultivation quality, and diversified factors between occupation competency and occupation demands from four dimensions including social needs, teaching process, talent cultivation quality and person-position matching with the involvement of associations,

industries, vocational education and management institutions, universities, and technical and vocational colleges.

3. THE CONSTRUCTION OF OCCUPATION COMPETENCY DEMANDS AND STANDARDS ORIENTED INTELLIGENT EDUCATION DYNAMIC ASSESSMENT PLATFORM

Occupation competency assessment examines the objects and identifies their competencies in specific occupational fields by constructing a standardized occupation competency model and assessment indicator system, using a questionnaire, test, operational assessment, skill competition, and vocational skill certificate according to specific pedagogical theory. It is also an important activity to monitor and evaluate the professional teaching quality on campus, and an important tool to guarantee and improve the quality of technical and vocational education. Occupation competency assessment takes the occupation requirements as the guidance and assesses the answers, scheme, operation, and results based on the occupation characteristics, technical standards, operation process, and social norms. The level recognition of occupation competency is determined by whether the assessment-taker meets the requirements of professional standards for assessment. It is also used as the basis for evaluating whether the assessment-taker matches the position and whether the educational objectives have been achieved.

In the era of intelligent education, the occupation competency-oriented intelligent dynamic assessment system is fully equipped with artificial intelligence, mobile Internet, cloud computing, big data, and other new technologies to conduct a systematic assessment of occupation demand, talent cultivation process, education achievements, and career performance after graduation.

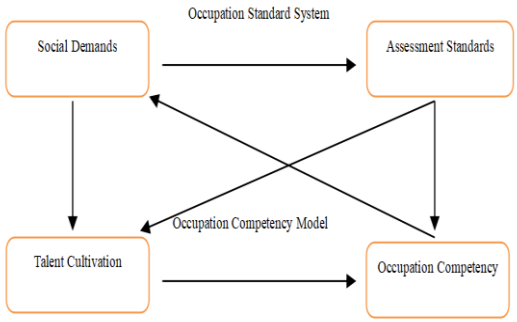

Figure 2. Occupation Competency Assessment System Model

3.1. Informationized Assessment Methods Empowered by Big Data

The design and technology of the intelligent dynamic assessment system must be capable of recording and analyzing student learning behavior and progress data, to realize the interconnection between the internal and external online resources. Online autonomous learning behaviors will be recorded, analyzed, and assessed. An offline and online dynamic learning and assessment system supported by big data is constructed here.

At the same time, it must link with the external information network to provide the dynamic demand information of the industry and occupation competency, make a dynamic assessment of the occupation competency from the demand side, and give periodic assessment reports and improvement strategy reports, to serve for students' learning process.

3.2. The Construction of Assessment Indicators Based on Occupation Competency Demands and Standards

Meanwhile Occupation standard is an important indicator to measure the qualification and occupation competency of laborers and can also be used to employ and evaluate employees in enterprises. Enterprises determine employment standards on their own according to production demands. However, the industry has benchmark attributes and unified requirements on employment standards. In cooperation with industry associations or enterprise associations, the state department in charge of labor and education can develop employment standards applicable to the industry, which is also been regarded as occupation competency standards. A national occupation competency standard system should be established to standardize and unify the enterprise employment standards, talent cultivation, and assessment standards in schools as the basis for education departments and schools to formulate talent cultivation specifications, occupation competency assessment indicator system, and diagnosis of education and teaching quality. The standards must be open to all industries, enterprises, educational institutions, schools, and experts to get involved. Dynamic adjustment can also be made according to the industry development, technology trends, occupation demands, occupation working situation, and responsibility requirements.

The important function of education is to serve economic development, and the cultivation of talents must meet the needs of society and industrial development. The specialty is closely linked with the industry to establish the education community. Occupational profiles can be used to describe key skill areas and levels of skills required to enter an occupation and successfully perform tasks[9]. Based on the

occupational profiles collected, the orientation and target of the professional talent cultivation and the talent cultivation quality standard should be formulated scientifically and reasonably. The talent cultivation knowledge structure can be extracted here. The curriculum should conform to the occupation standard and the technical standard to develop the curriculum and the teaching resources. Secondly, the occupation standards system and assessment standards are constituted by the formulation of industry occupation standards, job responsibilities, occupation competency standards, and the implementation of the indicator system based on the demands.

3.3. Openness to Dominant Industries and Multi-participants

The industrial demand-oriented talent cultivation model must adhere to open education, with a connected teaching process and production process, so as to construct dynamic learning ecology with the combination of on-campus teaching and online learning, real teaching and virtual learning, on-campus practice and enterprise practice.

An intelligent dynamic assessment system links the campus information-aided teaching system with social information networks together. A diversified assessment community is formed by the cooperation among government, schools, and industry. Data empower the system to timely grasp the social demand information and send occupation requirements and standards to the teachers and students on a regular basis, which makes education even more open and transparent. It also changes the traditional pattern that teachers go out to conduct research, predict talent demand, formulate talent cultivation specifications, and develop curriculum content according to sample survey results. Through big data technology, enterprise demand information is captured, cluster analysis is carried out, job portraits are given, and the ability requirements of talent cultivation are clarified. Through the occupation performance and social assessment of the graduates in various stages, the system evaluates the teaching quality from perspectives like knowledge, accomplishment and skills, occupation competency, innovative ideas, curriculum, and so on to get feedback. Occupation competency is served as a core indicator of talent cultivation quality. Enterprises determine what kind of person they are looking for.

4. THE DESIGN OF INTELLIGENT EDUCATION DYNAMIC ASSESSMENT PLATFORM

Sociopolitical and educational concerns have doubted the validity and usefulness of traditional testing and start to focus on the use of dynamic assessment (DA) in school settings[10]. Intelligent education dynamic assessment data platform is the technical support of the occupation competency intelligent assessment. With intelligent education as the core, it builds a big data analysis system that connects education managers, teachers, students, parents, employers, industry associations, and other social participants, and opens up the whole process of cultivation. The dynamic assessment data platform evaluates learning behavior, occupation competency, and occupation performance, which contains four subsystems: social demand assessment system, teaching process assessment system, talent cultivation quality assessment system, and intelligent position-person matching system. Integrated with government agencies, schools, teachers and enterprises, and society, the platform makes a comprehensive assessment of learners, a professional talent cultivation system, teaching management, and so on through modern education assessment technology and educational big data technology. Thus an intelligent education assessment system is formed with modules including social demand and talent cultivation, school enrollment and company employment, teaching and education, and new entry and career development.

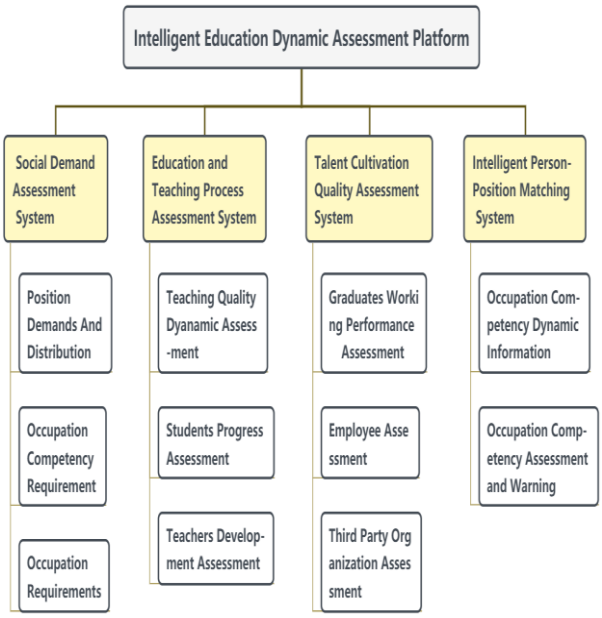

Figure.3 Systematic Framework of Intelligent Education Dynamic Assessment Data Platform

4.1. Social Demand Dynamic Assessment System

Xia Lixin, Chu Lin, Wang Zhongyi, and Shi Yijin proposed a relationship with the "Occupation-position-knowledge" model by delving into network text and verifying and analyzing its construction process through experiments[11]. The specific process is to collect the employment-related texts on the Internet, extract the relationship among majors, positions, and knowledge points through Chinese word segmentation and word labeling, form the

relationship set of "occupation-position" and "position-knowledge point", and finally display it intuitively in the form of visualization。

The social demand dynamic assessment system is equipped with functions including dynamic monitoring of positions number, corresponding social positions category distribution, company size, nature of the company, degree requirements, the experience requirements, salary characteristic analysis, regional distribution(key cities), position image analysis. The system captures and researches the text data of the talent demand on each recruitment website, including the number of positions, salary, job duties, qualifications, and related majors, to generate job portraits.

Position information is dynamically released through applications and the Campus Resource Planning (CRP) management system so that students can have a clear understanding of what positions they can be engaged in after graduation, and further have a comprehensive grasp of the skills and requirements required by these positions, so as to increase the employment competitiveness of the graduates. On the basis of improving the utilization rate of network information resources, the social demand dynamic assessment system can provide teaching and learning references for students in colleges and universities, so as to realize the connection between college talent cultivation and social demand.

4.2. Education and Teaching Process Assessment System

There are many problems in the current teaching quality assessment system in terms of assessment criteria, assessment function, assessment results after making deep research on the present situation, and strategies of teaching quality assessment in China[12]. They further pointed out that colleges and universities shall establish new assessment system with the core of developmental assessment, value-added assessment, perfect quality guarantee system, and monitoring system, and form a new assessment method which can emphasize process and promote advancement". Through the effective implementation of a developmental assessment mechanism, colleges can be encouraged to plan rationally and develop scientifically, so that students will be stimulated to learn, innovate, and create. Teachers will also take delight in dedication and all-around development.

4.2.1. Teaching Quality Dynamic Assessment

Driven by the new generation of information technology, the educational research supported by mobile Internet applications, ubiquitous network technology, and big data technology tends to be the analysis method in the full data environment. The big data will reconstruct the education and teaching assessment model, incorporate the vocational demand and standards into the curriculum and teaching quality assessment by data-based, conduct comprehensive assessment control and timely feedback on the teaching process, diagnose the quality of talent cultivation with students' professional competence as an important indicator, and form a mechanism for continuous improvement. The teaching units at all levels, such as college/department/course group, should keep abreast of the achievement of students' various learning objectives, analyze teaching effects, diagnose problems scientifically, adjust teaching strategies, constantly optimize curriculum system, teaching content, and teaching methods, and promote scientific management of teaching.

4.2.2. Student Progress Assessment

Student Progress Assessment System tracks and analyzes students' learning progress, psychological personality growth, professional and career development, and progress so that students can deepen their comprehensive understanding of themselves to “achieve self-education through self-assessment”. Participation in dynamic assessment is beneficial to the formation of students' intention of "actively participating in teaching activities". Various assessment methods shall be combined flexibly with campus social interaction to promote the "peer learning" of college students.

Through the progress report and other data services, the system guides college students to timely self-check their learning process, learning methods, learning results, and progress of comprehensive ability, to guide students to pay attention to their own learning and progress, develop good learning habits, and master effective learning methods.

The psychological growth assessment and analysis aims at the second development of all kinds of assessment scales according to the characteristics of college students, guide, students to comprehensively and objectively recognize themselves, such as intelligence structure, emotion, interest, beliefs, and other personality and characteristics, and promote the all-round and healthy growth of young people.

Through the timely feedback of social demand research results and students' various assessment data, students are guided to understand their own career interests, career motivation, career tendencies, objectively and scientifically formulate growth plans, foster strengths and circumvent weaknesses, and comprehensively measure all elements, and rationally choose careers.

4.2.3. Teacher Development Assessment

The teacher's development assessment helps teachers to develop their careers at the same time. The educational big data analysis service helps teachers understand their own pending projects and advantageous projects, urges teachers to continuously improve teaching quality, and makes teaching reflection, self-diagnosis, and improvement with the help of data analysis, to form their own teaching style. Decision-making and design teaching are based on student behavior and effect analysis. The traditional model of teaching decision-making, which relies on experience and fuzzy judgment, has been replaced. Teachers are able to understand students' feelings and acquisition situation in time, master the completion of learning goals of the classes and subjects, learn about the progress, analysis the inadequate parts of teaching. It also helps teachers know the teaching effect in time, make scientific analyses and diagnoses of problems, and adjust teaching strategies timely, so as to improve the teaching effect.

4.3. Talent Cultivation Quality Assessment System

Talent Cultivation Quality Assessment System applies to establish a comprehensive assessment system, linking employment (employing) units, industry associations, students and their parents, research institutions, and other talent cultivation and education-related parties to participate. The assessment of employment quality and employment competitiveness is conducted to track the career development of graduates. Assessment of professional certification/recognition and professional employment and development, according to the development orientation of the colleges and the characteristics of talent cultivation, implement the assessment of social recognition, social reputation, and professional development prospect, provide the reference for the development and improve its visibility and social recognition.

4.4. Intelligent Person-Position Matching System

The system regularly pushes vocational demand information and occupation competency reports, and intelligently matches and accurately recommends internship or employment positions for students based on big data analysis technology. Intelligent Person-Position Matching System can file each student with occupation competency progress. According to the students' profession, personal gross report, professional skill qualification level, occupation competency tendency, and social demand, the research result intelligently matches and accurately recommend internships and positions for students, and push the consulting report timely to the student, acting as an "intelligent professional planner".

It can also build a student competency certification system, periodically generate occupation competency reports for students, give strategic suggestions, and give a learning warning to students who fail to meet the standards. Students' competency comparison and position matching can be realized positions according to their abilities, so as to provide data-oriented employment services.

5. CONCLUSIONS

Driven by the new generation of information technology, the construction of the intelligent campus in the era of big data is inevitable for the information process for universities or colleges. This paper focuses on the application of new technology, interaction with education and teaching related parties, the whole process of talent cultivation to build the systematic structure of the intelligent education dynamic assessment platform, the key technology of subsystems, implementation approaches, value exploration of higher education-related subjects such as students, teachers, administrators, employers. Future research will continue to explore the application of big data, cloud computing, Internet of things, mobile Internet technology, virtual reality, and other new generation of information technology, effectively achieving six mainstream education services modes and measures including intelligent teaching, intelligent learning, intelligent management, intelligent research, intelligent assessment, intelligent service, optimize resource allocation, and develop the best practices of new technology application in the intelligent education ecosystem in the era of "Internet +".

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