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Research article

A novel Internet of Things-supported intelligent education management system implemented via collaboration of knowledge and data

Wenzheng Wei[1,*] and Ying Jin[2]

[1] School of Language and Culture, Anyang Preschool Education College, Anyang 455000, China
[2] Faculty of Foreign Languages and Business, Jiaozuo Normal College, Jiaozuo 454000, China

* **Correspondence:** Email: aywenzheng@126.com.

Abstract: The past decade has witnessed great progress in the Internet of Things (IoT), which can provide integrated platforms for data with various formats and to serve different parts of human society. Although IoT-supported education management systems have achieved some successful applications, most existing systems cannot perform intelligent information processing, such as autonomous planning and optimal scheduling. To remedy this gap, this work proposes a novel IoT-supported intelligent education management system that is implemented via collaboration of knowledge and data. First, the macroscopic architecture is designed according to field knowledge of education management, and a clustering-based data analysis algorithm is utilized to visualize real-time classroom characteristics. Then, statistics of learning status are generated, and personalized following plans are accordingly suggested to different specific users. Finally, the functions of the designed smart education management system are tested via computer simulation operations. The obtained results show that the proposal can work well under a real-time data stream and is expected to serve as a typical education management application in smart cities. Through verification, it is found that the integration of general education and professional courses is the ideal starting point for the design of the elements of an optimal course structure for engineering practice majors. In particular, we should strengthen the reform of the following course types: introduction to design, general education, concentrated practice, comprehensive design and peak courses.

Keywords: Internet of Things; knowledge discovery; data analysis; intelligent management systems

1. Introduction

Objectively, college English is still in a stage of general education because of the shortage of educational resources. The number of classes is too large, there are limited hours available for classes, the classroom teaching methods are relatively simple and the quality of teaching materials is uneven; because of the conditions of the computers and networks, the construction of students' independent learning systems is relatively backwards and teaching development is seriously inadequate, among other considerations. The shortage of resources on the whole leads to deficiencies in various elements of resources, among which the pressure due to the lack of time resources is particularly prominent. In actual college English teaching, time and resources are used inefficiently or even ineffectively due to the lack of other resources (such as teacher expertise, teaching material quality and teaching methods) or due to inadequate development. Some schools have noticed this problem; they have made improvements to create conditions to strengthen the reasonable use of teaching time, allow for effective expansion and careful management and improve the time utilization rate. Measures such as providing more extracurricular English activities, making full use of the computer network autonomous learning platform to carry out asynchronous teaching [1], decomposing classroom teaching content and extending it to the autonomous extracurricular learning platform, expanding students' academic learning time, breaking the in-class- and out-of-class boundaries, effectively expanding teaching time in the field and innovating the teaching practice of time management.

In teaching platform design, development, application and other aspects are at the forefront worldwide, with the emergence of a large number of open source network teaching platforms that strongly promote the application of network teaching platforms in universities and primary and secondary schools. From the perspective of functional development, foreign online teaching platforms have gone through four basic stages [2,3]. The first stage of development is a content management system. Teachers store and manage teaching resources to enrich the dissemination of knowledge. However, due to the disunity of the resource format and technology, it can only be used as a one-way dissemination of teaching and is difficult to share [4]. The second stage of development is learning the management system. From the training automation system, users can register and record the learning data of learners and courseware catalogue management. However, the production of teaching content cannot be carried out [5]. The third stage of development is to learn the content management system. This system is intended to help teachers who have no foundation in scripting language to design, create and manage online courses. In this stage, the online teaching platform can not only be used to track the learning progress of students but it can also be adjusted to meet the learning needs of learners. In addition, this system allows the sharing and interaction of learning contents [6]. The fourth stage of development is the establishment of the general network teaching platform. Based on the existing system, the general network teaching platform systematically integrates teaching resources, teaching processes (courseware development, teaching organization, evaluation) and teaching management, integrates the basic functions required by the platform and forms a relatively stable network teaching environment [7]. From the perspective of the industrialization process and the evolution of the industrial structures of developed countries, countries generally experience a wave of development in information technology after industrialization. However, the informatization that occurs in the process of industrialization and of adopting the strategy of "integration of the two" poses a challenge. Therefore, based on the current international situation, and after a profound introspection on the past and a reasonable inference about future trends, the new concept of "Integration of high modernization" is proposed. It accurately reflects what is seen in the development path [8].

In addition, in regard to English teaching time in colleges and universities, people pay more attention to explicit time or "hard time", i.e., the guarantee of teaching hours, while less attention is given to "soft time", i.e., the effective use of unit time. Teachers may think that as long as they devote their time to teaching or something related to teaching [9], their time is well spent. However, teaching time and teaching results do not have a naturally proportional relationship. It is important to teach about the concept of time in a way that will produce benefits and promote a correct view of time and time management consciousness. Many teachers may not think that time management is a problem that needs to be treated seriously or that careful planning and rational use of time will bring great teaching benefits [10]. They tend to monopolize the class time or simply allocate teaching time that leaves little time for student interaction, let alone active learning. According to the Carroll model, the variation in teaching time and teaching quality is influenced by both teaching and learning, teachers' teaching levels and students' learning situations. In Carol's model on time for humanity, he thinks that the individual internal factors that affect student learning outcomes (aptitude, understand teaching ability and perseverance) and the external conditions (learning opportunities and the quality of teaching), and ultimately, the five elements in the reduction of time [11], in order to study time, from the angle of view of the time and meaning for people, make the inflexible clock time vivid and the extension of the time concept more rich and wonderful. In particular, the concept of learning time is actually a description of the characteristics and qualities of the teaching subject, emphasising the key role of the subject in determining the success or failure of teaching [12]. Specifically, 1) aptitude refers to the amount of time required for students to master a task under optimal learning conditions. Students who need less time have higher ability tendencies. The more time needed, the lower the ability tendencies [13]. 2) Ability is the to capacity to understand instruction, including general intelligence and verbal ability. General intelligence refers to the ability of students to understand conceptual relationships and reasoning in teaching materials, and verbal ability refers to the ability of students to understand the special vocabulary used by teachers. The level of these two abilities directly affects the length of time it takes for students to master learning tasks [14]. 3) Quality of instruction refers to the foundation provided by the teaching according to the ability tendency, and in which students do not need to increase the amount of time to master the material [15]. 4) Perseverance refers to the amount of time that a student will devote to his studies actively and proactively. 5) Learning opportunity refers to the amount of time allowed for students to learn, i.e., the permitted time [16]. The three variables of aptitude, perseverance and learning opportunity can be directly expressed by time, and the understanding of teaching ability and teaching quality can also be expressed by time if measuring tools and experimental operations are used. "Allowed learning time" (or learning opportunity) in the above model refers to the time allocated to learning tasks, which is limited by schools' time allocation regulations [17] and teachers' time allocation for each specific learning task. There is also research on the teaching design mode of flipped classrooms based on SPOCs in colleges and universities. At the same time, the teaching content has also changed significantly. Learning content is not limited to the knowledge in textbooks, and textbooks are no longer the main teaching resources. Digital teaching resources have become the focus of attention in the field of education because of their richness and novelty, and a large number of teaching resources are available for teachers and students to use [18]. In class, a variety of resources can be quickly obtained through the internet, and a variety of learning problems can be quickly obtained through answers to information queries. In extracurricular settings, teachers can use information means to carry out lesson preparation and access various forms of teaching resources, such as pictures and text, and students can also carry out personalized learning. The application of practical engineering requirements to mathematics classrooms requires changes to the teaching content and presentation methods. For example, multimedia graphics can be used to display the teaching content, and the resources on the internet can be used to provide up-to-date teaching content [19]. With the development of network technology, intelligent teaching is becoming an emerging research field that is characterized by networking and individuation, providing more artificial intelligence services and adapting to personalized learning. For example, students' learning situations can be tracked in real time through tablets in class by methods such as tracking answers to classroom quizzes and students' concentration in class. There is also diversity in teaching methods. Traditional teaching methods include lecturing, discussion and demonstration. Most of these teaching methods are teacher-oriented, with less interaction between teachers and students. However, with the support of tools to support practical engineering requirements such as electronic whiteboards and electronic schoolbags, the emergence of these requirements has enriched the interaction between teachers and students, and teaching methods such as group collaboration and inquiry have gradually been integrated into the classroom [20,21]. The interactive electronic whiteboard has changed the way teachers teach and the way students learn and has also changed and increased the methods and frequency of interaction between teachers and students [22]. With the aim of promoting the innovation in talent training through informatization, a group of different professional and technical talents and teaching staff are trained to adapt to the needs of different stages of educational informatization. Oriented by applications, this creates an application environment through infrastructure construction, expands application channels by teaching and scientific research, promotes application efficiency through training and improves the application level through evaluation [23–25]. Because of the practical needs of modern engineering, higher education also needs significant reform and innovation, which has led to promoting the modernization of educational content, teaching means and teaching methods, innovating the mode of talent training, scientific research organization and social services, promoting cultural inheritance and innovation, and thus promoting the overall improvement of the quality of higher education.

With the rapid current development, education should adapt in order to catch up. The reform of the curriculum system for practical engineering needs is inevitable. This paper takes the critical reform of the curriculum system in the research process, while facing the "integration of the two"; the past "curriculum system" obviously has some adaptive parts, but also many maladaptive parts. It is necessary to "advance with the times" and carry out curriculum reform. From the point of view of the requirements in the engineering practice curriculum system, curriculum research on pedagogy-related concepts has progressed from adhering to the knowledge connotation (reading a text), to posing a question (from confusion to reflection), making a discernment (the value orientation of the curriculum) performing system construction ("two combination" oriented curriculum system constructing) and to exploring the train of thought of the research. The structure of this paper is as follows: The first part is the introduction; the second part is the architecture of the college English teaching system for practical engineering needs; the third part is the experimental design; the fourth part is the results and analysis; and the fifth part is the conclusion.

2. Systematic architecture of the education management system

2.1. Overall design of the system architecture

The College English teaching system is a Web system based on the B/S mode LAMP (Linux Apache Mysql Php) structure. The client runs in the user's web browser, and the main work is processed in the server. It is a typical thin client architecture. Based on the above theoretical and technical analysis and demand discussion [7], the overall system architecture is designed as shown in Figure 1: system architecture takes the perspective of the curriculum system of design majors and relies on the related concepts of pedagogy curriculum research. It follows the construction of erudition (connotation interpretation), interrogation (from confusion to reflection), careful thinking (value orientation analysis of curriculum system construction) and discernment (construction of curriculum system for integration of the two).

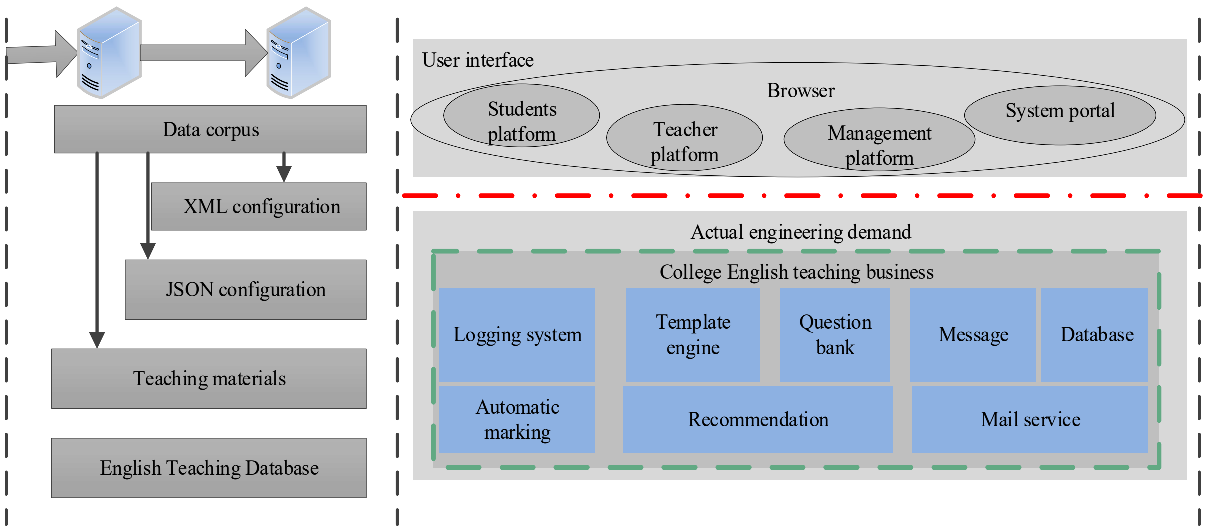

Figure 1. Overall system architecture.

As the core part of the college English teaching system, student platforms and teacher platforms are directly applied to the teaching of English writing. Teachers in the classroom or in the students' post-class homework platform assign the class composition work; after receiving a notice, the students finish writing on the platform, the automatic marking module corrects the composition and according to the results of the automatic correcting function, the teacher on the online platform examines the composition to finalise the grade and provide corrections; after completion, the system pushes the overall review feedback to students. At the same time, students can also carry out writing practice through the independent practice module in the student platform to improve their writing abilities.

A school management platform is set up to help school administrators keep abreast of the English writing teaching trends in the school, students' writing level, manage teachers and students in the school, issue announcements and organize activities related to composition. The system management platform is the visual platform of the whole system's backstage management, including the question bank management, school management, system update and maintenance subsystems.

The system portal is a content management system used to display the college English teaching system so that the first contact quickly understands the functions and characteristics of the system. Automatic marking services, personalized recommendation services, database services and mail services, which are the foundation of other functions, are important components of the system server. The scientific research interface provides data support for related research work.

2.2. Registration for clinical trials on the practical demand of engineering and classroom teaching transformation of college English teaching

Because of the influence of concepts such as "knowledge-based" and "teacher-centred" methods, the teaching processes and techniques in colleges and universities are relatively simple, and classroom teaching in colleges and universities has not been fully enhanced through more diversified and modern ways. Teachers in colleges and universities have a certain information-based teaching ability, but because of the influence of "Internet+", developing an effective teaching ability is insufficient; when confronted with the main teaching form, there is still great development in the demand innovation in the engineering practice teaching mode and research ability as actual demand engineering is involved in the classroom teaching of colleges and universities. This will bring a process of fundamental change to the classroom teaching structure. As shown in Figure 2, before technology entered the classroom, teaching mainly depended on face-to-face interpersonal interaction between teachers and students in the classroom, which is a fixed and closed physical space. In terms of interaction, due to the lack of technical means, the interaction between teachers and students in teaching presented a teacher-centred radial structure. Interaction in the classroom teaching process mainly occurred between teachers and students, and such interaction was one-way to a large extent. There was no interaction between students, and such interaction was even forbidden in the traditional classroom because it would interfere with the interaction between teachers and students. In this case, the teacher was the undisputed pivotal position in the classroom teaching structure and therefore the unquestioned authority in classroom teaching. If teachers were absent, the whole structure of classroom teaching would quickly disintegrate, and teaching was not sustainable. Looking again at Figure 3, after the new technology entered the classroom, it provides a new choice for the interaction between teachers and students in addition to point-to-point interaction based on face-to-face interpersonal interaction, thus fundamentally reconstructing the basic structure of classroom teaching and transforming it from a highly centralized radial structure to a relatively low centralized network structure. In this new structure, there is interaction not only between teachers and students but also between students and students. The direct result of student interaction is that students change from passive consumers in the traditional classroom teaching structure into important learning resources and partners for their peers. Compared with the traditional radial in-classroom teaching structure, due to the project and the actual demand in this new type of network teaching structure with stronger stability, students have a greater status in this structure. In the new structure, teachers, although still in a relatively important hub node, do not have clearly undisputed authority, nor do they dominate classroom teaching. In this case, if the teachers can adapt to the new teaching structure, then they will be able to fully play their roles to lead the evolution of the new teaching ecosystem and the level of the higher order; in contrast, if we cannot adapt to the new teaching structure, teachers' position as a hub node of importance will be further degraded and students will become a common point in this network structure; teachers will eventually lose the opportunity to perform their roles and will not be able to lead the classroom in teaching.

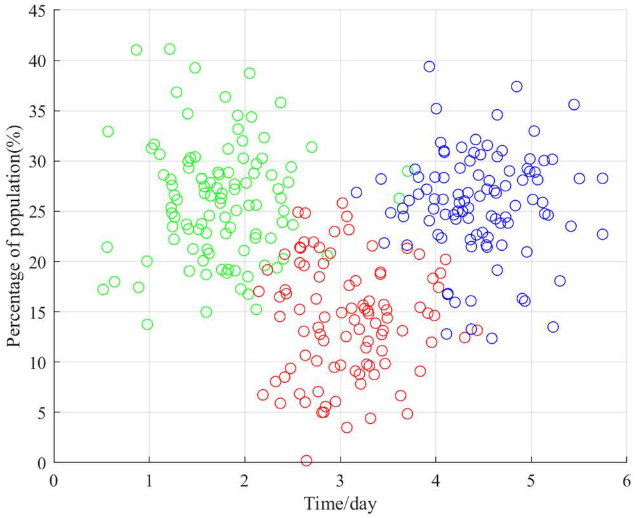

Figure 2. Traditional classroom teaching structure.

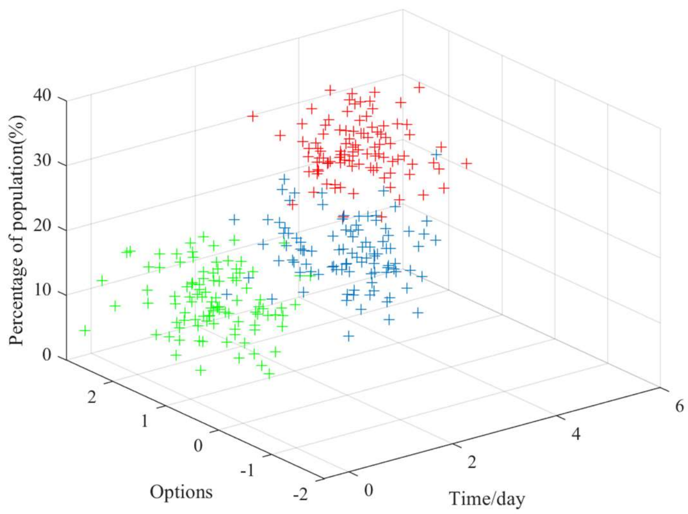

Figure 3. New classroom teaching structure.

What kinds of teaching methods teachers choose has a great influence on students' learning interest, the learning effect and the teaching effect. This study investigated the teaching methods currently used in English College teaching, as shown in Table 1.

Table 1 shows that English teachers in colleges and universities are mainly lecturing at present. In addition to lecturing, cooperative teaching methods are often adopted by teachers, and autonomous and exploratory teaching methods are seldom adopted. In class, teachers often organize students to study in groups. A total of 60.35% of the students expressed their preferences for diversified teaching organizations. At present, English teaching in colleges and universities is mainly teacher-taught, and students show their expectations for diversified teaching forms.

Table 1. Status quo of teaching methods adopted by teachers.

Problem	Options	Number	Percentage
What kinds of teaching methods do English teachers often use?	Teaching	227	46.35%
	Independent methods	26	5.08%
	Cooperation	183	37.43%
	Exploration	57	11.15%
How often do English teachers use group learning in the classroom?	Often	425	85.4%
	Less often	67	12.48%
	Never	6	1.23%
Do you like the variety of teaching forms?	Like it very much	297	60.35%
	Like somewhat	154	31.24%
	Neutral	39	7.74%
	Do not like	2	0.3%
	Dislike very much	1	0.25%

Whether in class or after class, the interaction between teachers and students can help teachers better grasp the problems of students in learning, and teachers can adjust their teaching in a timely manner or give targeted guidance to students. This study investigates the current interaction between college English teachers and students, as shown in Table 2.

Table 2. Investigation on the status of teacher-student interaction.

Problem	Options	Number	Percentage
What do you think of the interaction between teachers and students in classroom teaching?	Positive interaction between teachers and students	463	93.32%
	Not responsive enough to students	29	6.08%
	Not paying attention to communication with students	3	0.42%
	No interaction	2	0.3%
Do you use the internet to communicate with your teachers or classmates when you encounter problems in English learning?	Very often	146	29.42%
	Often	143	28.7%
	Very seldom	167	33.46%
	Never	42	8.33%

As shown in Table 2, 93.32% of teachers and students interact positively in English teaching. The proportion of students who were not sensitive enough was 6.08%, and 0.42% of the students said that English teachers did not pay attention to communication with students in class. Regarding whether students communicate with teachers or classmates on the internet when they encounter problems in English learning, 29.42% of the students said that they often communicate with teachers or classmates on the internet. A total of 28.7% of the students thought that they often communicated with English teachers or classmates through the internet. However, 33.46% of the students said that they seldom communicate with English teachers or classmates on the internet. In addition, 8.33% of students did not use the internet to communicate with teachers or classmates when they encountered problems in English learning. It can be seen from the survey data that English teachers actively interact with students in class, but there is less interaction between students and teachers after class, and the frequency of communication needs to be improved.

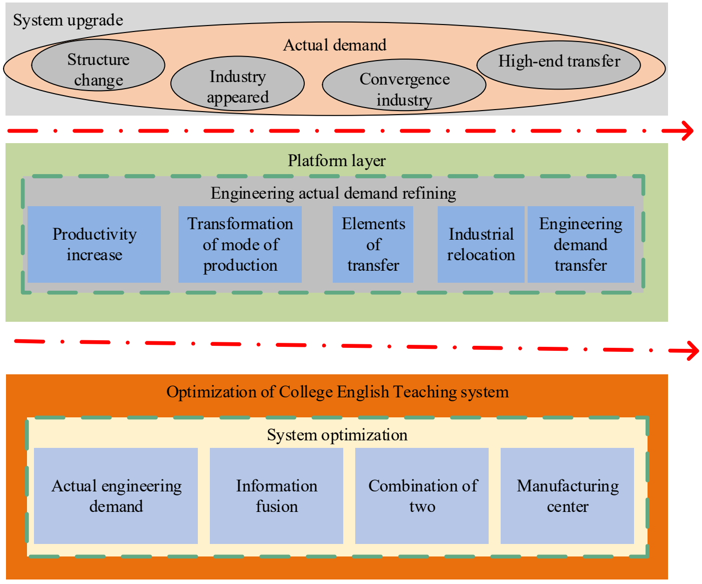

Figure 4. Upgrading of College English teaching according to the demand of the "integration of high modernization" project.

2.3. *Mutual promotion of the "integration of industrialization and modernization" and the actual demand for engineering*

"Integration" means that informatization and industrialization are not an either-or relationship or a simple splicing but that mutual infiltration and development occurs. Integration occurs not only in technology, management, sales and other aspects but also aspects such as in productivity, lifestyle and the social form. From a moderate point of view, the "integration of industrialization and modernization" can transform and upgrade the traditional industry and promote the upgrading of the industry to take a path of leapfrog development in industrialization. We should adapt to the typical characteristics of the "integration of two industries" manufacturing industry and reform the current traditional production operation modes to realize the deep integration of the manufacturing industry and the actual engineering demand.

It can be seen from the mechanism diagram of the transformation of traditional industries by the integration of industrialization and industrialization in Figure 4 that the contents of the "integration of industrialization and industrialization", such as industrial products, industrial equipment, industrial production, sales and the process of industrial management, are closely related to the actual engineering needs. The practical engineering of demand can be considered an applied technology that is mainly characterized by intellectual labour with creativity. The specific task of engineering actual demand involves developing new products, with these products as the carriers. The cycle of starting the production of new products, putting them on the market to promote consumption, and then promoting production with consumption plays an important role in the process of the "integration of the two". Not paying attention to the actual demand of engineering, the economy is built on the repeated manufacturing and processing of old products, which will cause the economic system to be in a disadvantageous position. Especially in current high science and technology, the main factor of productivity is no longer physical strength but knowledge and intelligence. Knowledge and intelligence are the most important factors in engineering actual demand. A good design can create a quite high added value for products. Currently, the actual demand for engineering is an important factor in developing the economy and culture and has created new norms for the production and lifestyle of modern humans. Therefore, the actual demand for engineering is a necessary factor for the social development of the "integration of industrialization and modernization" and the key to the improvement of its comprehensive national strength.

After making clear the status of College English teaching in school teaching, we further investigated the value choice of College English teaching. After preliminary interviews, we designed five possible value choices. They are the following: improving students' comprehensive literacy, improving students' professional English abilities, improving students' pass rates of the CET-4 and CET-6 exams, improve students' workplace English application ability and improving students' test-taking abilities for other English exams (such as postgraduate entrance examinations, the TOEFL). (See Table 3 for details).

Table 3. Statistics of possible value selection in College English.

	Comprehensive university	Trade university	Foreign language college
	Frequency	Frequency	Frequency
Improve students' comprehensive English application ability	7	6	5
Improve students' professional English ability	4	4	3
Improve the pass rates of students in the CET-4 and CET-6 exams	3	1	3
Improve students' English application abilities in the workplace	3	4	5
Improve students' test -taking abilities for other English tests (such as postgraduate entrance examinations, the TOEFL, etc.)	1	2	3

On the selection of College English value choices, the value of comprehensive universities in three types of options as a result, sorted by the number of value options is selected, and the order is the following: 1) improving the students' English comprehensive application ability; 2) improving the students' professional English application abilities; 3) improving the students' abilities in specialized English came in third place. Improving students' passing rate of CET-4 and CET-6 (seven times) ranked fourth, while improving students' test-taking abilities for other English tests (such as postgraduate entrance examinations, the TOEFL) ranked fifth (six times).

The diversity of learning and teaching methods is mainly reflected in the diversity of the following three aspects: the diversity of learners' learning methods, the diversity of teachers' presentation of learning content to students and the diversity of interactions between teachers and students. The diversification of learners' learning styles means that in the information environment, learners' learning styles are different from those in the traditional teaching environment, where learners just passively accept the knowledge transmitted by teachers. Learners should give full play to their own initiatives and become the masters of their own learning. In this case, the subject status of learners should also be fully reflected. The actual engineering demand is integrated with education and teaching in the form of tools, and this demand is integrated into all elements of the education and teaching system, making it a teaching tool for teachers, a cognitive tool for students, an important form of teaching materials and a major form of teaching media. In other words, in the teaching process, the actual engineering needs, information resources, information methods, human resources and teaching content are organically combined to formulate the teaching tasks for a new teaching method. The integration of practical engineering demand and education and teaching will continuously promote the process of educational informatization and the form of informational education.

2.4. Experimental design

In the first semester of 2022, a total of four classes at X University were selected for the experiment, in which one sophomore class (A) was the experimental class, one sophomore class (B) was the control class, one junior class (A) was the experimental class and one junior class (B) was the control class. The experimental class and the control class of the same grade were taught by the same English teacher. At the beginning of practice, to further understand the situation of the four classes, the results of the four classes of grade two and grade three were identified. See Table 4 for the specific differences.

Table 4. Comparison of English proficiency between the control classes and experimental classes before practice.

Class	Number	Average	Highest	Lowest points	The number of people with more than 100 points	Between 100 and 72 points	The number of people with less than 72 points
Grade 2 experimental class	53	92.4	117	42	16 people	27 people	11 people
Grade 2 control class	53	95.5	118	44	13 people	25 people	9 people
Grade 3 experimental class	49	91	114	27	26 people	18 people	8 people
Grade 3 control class	51	89.5	115	33	22 people	24 people	4 people

3. Results and analysis

Considering enterprises' evaluation of graduates' knowledge, quality and ability is an important way to deeply understand the effect of curriculum implementation and investigate the adaptability of curriculum and society. For students with practical engineering needs, the overall evaluation of graduates' abilities by enterprises is particularly important. In the questionnaire, employers' overall satisfaction with graduates' abilities is used to reflect enterprises' judgement of graduates. In addition, the survey also takes into account employers' evaluation of graduates' knowledge and quality. See

Figure 5 for the statistical results of overall satisfaction of graduates' knowledge, abilities and quality with actual engineering needs.

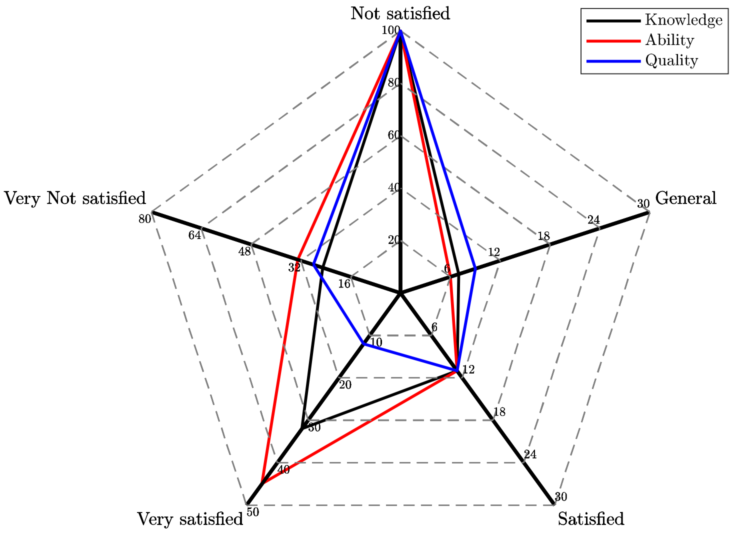

Figure 5. Overall satisfaction of graduates with actual engineering demand.

3.1. Figure/image and caption

It can be clearly seen from the radar analysis chart that more than 50% of employers' evaluations of satisfaction with knowledge, abilities and quality were in the ranges of average, dissatisfied and very dissatisfied. Among them, the proportion of those who had satisfaction with knowledge mastery (36%) was much lower than the proportion of those who answered neutral and dissatisfied (49%); the proportion of those who were satisfied with the graduates' abilities (28%) was significantly lower than that of those who were not satisfied or dissatisfied (50%). The proportion of those who were satisfied with quality (50%) was significantly higher than those who answered neutral and dissatisfied (37%). It can be seen that the recognition of ability and knowledge is lower than that of quality in the evaluation of the effect of the educational curriculum on engineering practical demand.

The enterprises' satisfaction with graduates' ability is the most concerning issue in this study. Among the 15 design professional competencies listed, five levels of satisfaction were set: very dissatisfied, dissatisfied, average, satisfied and very satisfied. In the dimension reduction analysis of satisfaction, that is, after removing the two dimensions of "very dissatisfied" and "very satisfied", the composition of employers' satisfaction with the 13 competencies is shown in Figure 6.

Figure 6 shows that the overall evaluation of the 13 competencies by most employers is "fair", with an average of more than 400 U: the proportion of satisfaction with each competency is less than 30% on average. It can be seen that employers are not satisfied with the overall ability of graduates majoring in engineering practical needs. If the "neutral" assessment and evaluation of "not satisfied" are combined to represent that employers are not satisfied, satisfaction is high for the following five abilities: design project planning and management capacity, access, analysis, screening, ability of applying information, the consciousness of lifelong learning and action, designing systems or products under the conditions of limits, identifying, defining and developing abilities in design problem solving skills. Therefore, it can be seen that the reasons for the low satisfaction with the first five abilities are due to the content of the course or the methods of course implementation, and the training effect of the course is still insufficient.

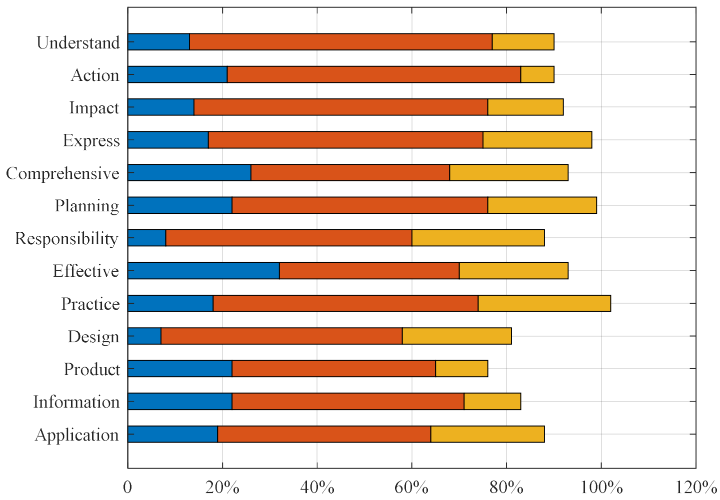

Figure 6. Graduates' ability satisfaction with actual engineering demand.

Finally, in the questionnaire, employers are asked to give a score to the overall ability of graduates with practical engineering needs. The distribution is shown in Figure 7, which further reflects whether the actual engineering needs of graduates meet the needs of enterprises. With a full score of 5, a survey result shows that the mean score of employers is 2.46, the minimum value is 1, the maximum value is 5 and the sample number is 920. Employers think that the actual engineering demand of graduates meets the social demand of "integration of industrialization and modernization" to a general degree.

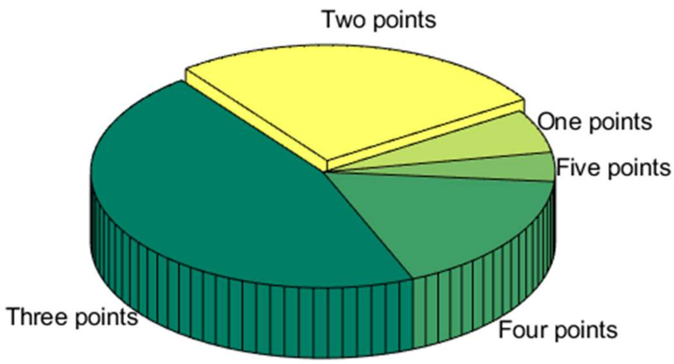

Figure 7. Degree of conformity between the actual demand of engineering graduates and the social demand of "integration of industrialization and modernization".

Through sorting out the viewpoints of stakeholders, it is concluded that under the background of "integration of the two", talent needed by modern enterprises should have the following requirements: first, basic professional knowledge, understanding the current development focus and development ideas of enterprises and the ability to conduct in-depth analysis of the current design problems of enterprises; and second, basic information technology knowledge. It is important for talent to understand the basic knowledge of information technology and the development trend of information technology to ensure that enterprise information construction is in line with development trends. Third, talent should have comprehensive business knowledge, a comprehensive grasp of the internal process and system of the enterprise and understand the business development process. Fourth, talent should have good comprehensive skills, including teamwork, organizational communication, problem solving, presentation and reporting skills. According to the demands of current enterprises, talent with practical engineering needs cultivated by the professional curriculum system of practical engineering needs cannot meet the needs of current society.

In this study, the information of the personal characteristics of students is mainly the data of the time when students log on the platform to study. The learning time recorded by the College English teaching system platform mainly refers to the time students go online. By recording the login time of students on the platform, teachers can determine whether the learning time of students conforms to the actual time required. The author exported the data table according to the platform and numbered the students in turn. The specific learning time of the experimental class students from two grades on the platform is shown in Figure 8.

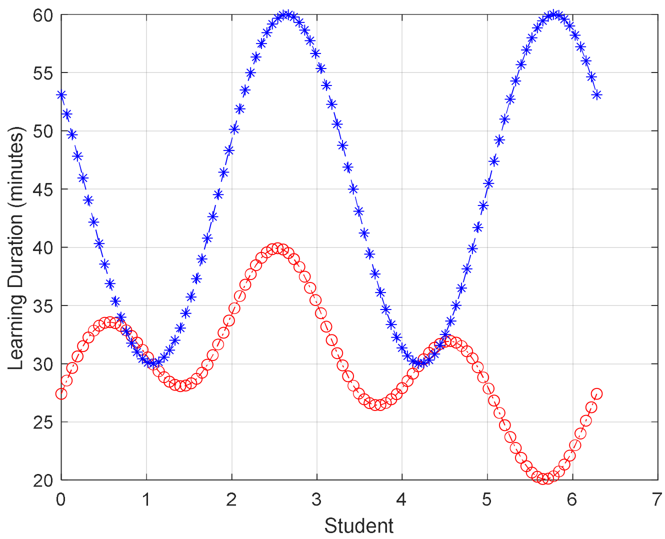

Figure 8. Student login learning time diagram.

The resulting factor of behaviour is commonly referred to as reinforcement, which can stimulate and maintain the motivation of behaviour and can be used to control and regulate human behaviour. For students, the result of their behaviour in class is their academic performance, while the self-efficacy of students refers to the degree of self-confidence of an individual in a certain behavioural ability in a specific situation. The individual's expectation, perception and confidence of his or her behavioural ability is required to successfully implement and achieve a specific goal. This is a dynamic factor between motivation and behaviour. There have been data showing that the use of microteaching assistants can significantly improve students' academic performance, so this result also strengthens students' learning behaviour and thus enhances students' sense of self-efficacy. Of course, it is also related to students' learning motivation. Studies have shown that learning motivation has a very significant positive correlation with academic performance. The higher the internal motivation of students, the more the behavioural tendency of active learning will increase, so academic performance will improve. According to the statistical results, there is also a linear relationship between students' classroom activity and classroom achievement, as shown in Figure 9.

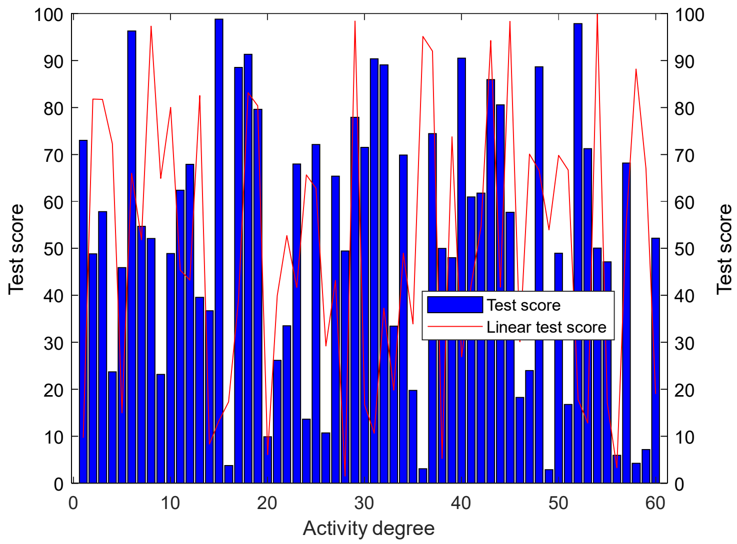

Figure 9. Correlation between test scores and classroom activity.

4. Conclusions

This study proposes the "modular curriculum structure model", which provides a reference to change the traditional curriculum structure dominated by the subject knowledge system. The modular curriculum structure model is divided into two levels: top-level design and element design. First, the proposed curriculum structure of engineering practice demand education is divided into five modules: the general education curriculum module, design specialty curriculum module, engineering practice demand specialty curriculum module, engineering practice demand practice curriculum module and peak course module. Second, the optimization of the professional curriculum structure in engineering practice should start with the integration of general education and professional curriculum. In particular, the reform of the introduction to design courses should be strengthened in the curriculum. In conclusion, the "professional competence of practical engineering needs" framework and the "modular curriculum structure" model proposed in this study are more suitable for the curriculum objectives of practical engineering needs education of application-oriented universities, taking into account the selection and adjustment of different schools and majors, so it has strong pertinence and high flexibility. The next step is to study the educational ecosystem from a dynamic perspective because the balance of the system is relative, while the imbalance is absolute, and dynamic development is the main state of the system. Future investigations on the ecology of college English classrooms should break through the limitations of this study, adopt a combination of qualitative and quantitative research methods and apply the relevant theories of ecology and systems science at a deeper level to conduct dynamic interdisciplinary research.

Conflict of interest

The authors declare there is no conflict of interest.

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