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Thinking in the Post-Epidemic Era: Research on Full-Time Online Experimental Teaching of the Internet of Things

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Abstract: *Experiment is an important part of engineering teaching. Through experiment, students can deeply understand theoretical knowledge and cultivate practical ability. Good experimental environment and rich experimental content can often become a bridge between students and enterprises, and effectively bridge the gap between industrial talent, skill demand and actual training and course teaching. However, the sudden events such as COVID-19's epidemic situation have posed a challenge to the traditional experimental form based on offline operation. Therefore, this paper takes the Internet of things engineering major as the background, and adopts the concept of full-time online (All-Online) to discuss and study the online and offline integration of experimental teaching. First of all, this paper expounds the problems existing in the experimental teaching of the Internet of things engineering specialty in our school; secondly, the problem-oriented work is discussed in detail, including the construction of the mapping model between the curriculum group and the experimental group and the full-time online driving model. An integrated cloud-based experimental platform group of the Internet of things is developed, on the basis of which a new double closed-loop experimental teaching method of full-time online and offline learning is designed and formed. Through this way, we can effectively establish a new talent training mode of "three-stage integration" from university education, enterprise employment to lifelong learning, and finally realize the talent training goal of "teaching-practice-practice-use-refinement".*

Keywords: *New engineering talent training; engineering experimental teaching; all online; online and offline integration; cloud Internet of Things experimental platform group*

1. Introduction

COVID-19 has caused tremendous human and property losses in China, and has had a serious impact on many fields, including education [1]. The repeated sporadic cases in particular indicate that the impact will continue for some time to come. During the epidemic, education authorities required that "classes should be suspended and online education should be actively carried out" [2]. Therefore, professional groups represented by university teachers became "video anchors" to actively carry out online teaching. Although the teaching effect was slightly affected, it still maintained a good situation on the whole, thanks to the close cooperation between teachers and students. However, it has a great impact on the teaching of engineering majors which need experimental support, especially those courses which need professional experimental environment.

As a major country in higher education and vocational education, China has started to carry out the construction of national virtual simulation experimental teaching centers since 2013 [3]. After nearly ten years of construction, a number of experimental teaching simulation platforms with distinct disciplinary characteristics and industrial demands have been formed. However, most of them are experimental teaching applied to traditional dominant disciplines, which is difficult to meet the requirements of new disciplines, new majors and new professions in the background of "new engineering" [4] for experimental teaching content and environment. For this reason, some domestic scholars have carried out relevant studies.Similar to the above studies, the major of Internet of Things engineering in our school [5] also introduced content including online industrial control experiment platform and smart home experiment platform in the early laboratory construction. Although it has played a huge role in the teaching of the novel coronavirus epidemic, it also presents obvious shortcomings. The root cause is that the traditional

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rigid thinking of talent training cannot adapt to the new impact of the special situation of the novel coronavirus epidemic and the new demand of modern enterprises for talents, especially the current "three-stage integration" mode of talent training, which includes college education, enterprise employment and lifelong learning, as shown in Figure 1.

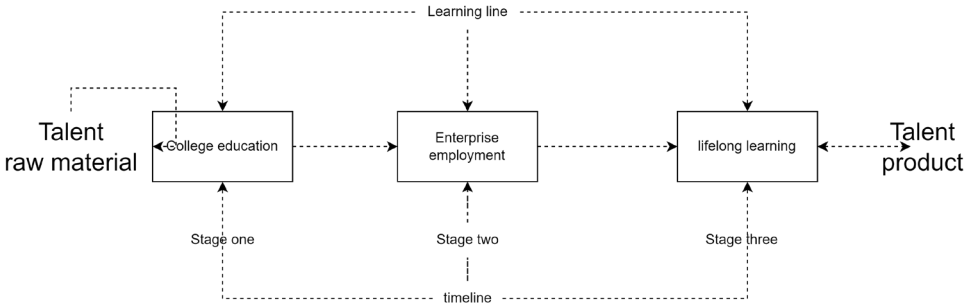

Figure 1: "Three-stage integration" talent training model

In the post-epidemic era, it is necessary to think more deeply about the experimental mode combining online and offline, and explore the new experimental teaching mode of "All-Online", that is, to provide students with a full-time online experimental environment, allowing and guiding students to conduct experimental training anytime and anywhere, so as to effectively consolidate theoretical knowledge. The new teaching mode will change in personnel training, course system, course content, experimental arrangement, experimental environment, experimental form, teaching form and examination form, among which the most critical is to break through the solidified thinking mode in personnel training and combine the new idea of "All-Online" experimental teaching with the new idea of professional personnel training. In order to cope with the future of all kinds of unexpected situations of talent training needs.

Therefore, this paper takes the Internet of Things engineering major offered by our school in recent years as the object, and takes three core professional courses of "Linux intelligent programming", "Intelligent perception Technology" and "Internet of Things Perceptual Technology course design" as examples to carry out online and offline integration exploration of experimental teaching of Internet of Things engineering major based on the concept of "All-Online". Under the background of new engineering, a new teaching experiment method with the characteristics of our school is formed.

2. Problems and challenges in experimental teaching of Internet of Things Engineering

2.1 How to reconstruct curriculum system

At present, the majors in the Internet of Things in many universities in our country developed from measurement and control technology, Communications Engineering or Computer science and technology [6-8]. They follow the training objectives, training mode and curriculum system of traditional majors. But the curriculum system of traditional majors does not take into account the transformation of "new engineering" education and the change of career development in "new professions". Therefore, it is difficult to meet the actual demand of enterprises for skilled talents [9]. Therefore, reconstructing curriculum system is an important basis for promoting experimental teaching.

2.2 How to build the mapping relationship between curriculum group and experimental group

Internet of Things engineering is the important direction of informationization transition and construction in our country. It is also the new major in our university. It has good development prospects and great social demand. This major aims to cultivate practical application-oriented engineers of the Internet of Things. Therefore, in the designation of the training program, emphasis is placed on the idea of attaching equal importance to teaching courses and experiments. However, the curriculum and experiment arrangement still continue the form of traditional engineering majors [10]. As a result, the connection between courses and the effectiveness of experimental Settings cannot meet the requirements of the new engineering major which is oriented to practical application.

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2.3 How to create a new experimental teaching mode integrating online and offline on the basis of the existing offline experimental environment

Benefiting from the advantages of the Internet of Things technology, the existing offline experimental equipment has a good foundation of network connection and the potential of online cloud. Therefore, on the basis of unified experimental software and hardware architecture, it is necessary to focus on top-level design, transform and develop an online and offline integrated experimental teaching platform suitable for future needs, build a full-time online experimental mode, track the experiment trajectory of students, deeply perceive and excavate the difficulties in students' experimental learning and give timely feedback, so that teachers can fully grasp the experiment dynamics of students. Combined with online question-answering to solve students' problems quickly, forming online learning closed loop; When offline conditions are available, theoretical teaching and experiments should be further consolidated to realize the closed loop of offline learning, so as to finally realize the new model of "All-Online" double closed loop experiment of online and offline learning.

3. Discussion on Online and Offline Experimental Teaching Reform based on "All-Online" concept

3.1 Concept of "All-Online"

"All-Online", also known as full-time online, is a lifelong online learning concept first seen in foreign network security communities. The core of this concept is to provide users with a full-time online learning mode limited only by laws, ethics and rules, but not by space and time, through information technology and network technology. It advocates and carries out anytime, anywhere, practical and effective, as shown in Figure 2. Because of its ability to build a bridge of strong connection and loose coupling between talents and enterprises, the concept is being applied beyond the network security community to more fields, including the Internet of Things.

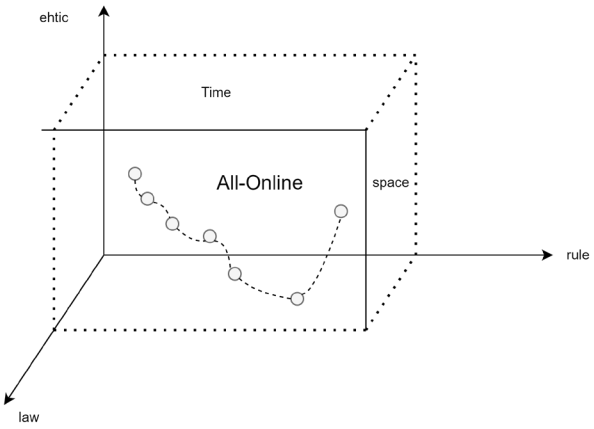

Figure 2: "All-Online" concept

3.2 Objectives of experimental teaching reform

The teaching objectives and syllabus of the major of Internet of Things engineering are thoroughly sorted out, the types and specific contents of courses with offline experiments are studied, the experimental system is mapped with the depth of the curriculum system, the experimental group is closely connected with the curriculum group, and the integrated experiment that goes through the core curriculum learning of the whole major is perfected and innovated. Through the form of "All-Online" to create a full-time online integration of online and offline integration experiment mode, guide students to carry out experimental training anytime and anywhere, so as to effectively consolidate theoretical knowledge.

3.3 Experimental teaching reform methods

(1)Perfect the construction of professional curriculum system, and construct the mapping relationship between curriculum group and experimental group.

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Starting from the background of "new engineering" and the actual needs of enterprises, we aim at practical application and precise training. First of all, the rationality and effectiveness of the topic system of the Internet of Things engineering major is deeply studied, including the sorting and discussion of course categories, forms of cohesion, class arrangements, examination forms, etc. Secondly, the mapping relationship model between curriculum and experiment is constructed, the comprehensive evaluation index of matching degree is designed, and the mapping and matching relationship between curriculum and experiment groups is fully evaluated. By integrating the two variables of new teaching model and enterprise employment requirements, the matching relationship between curriculum and experiment groups is modified and improved, and the depth mapping between the two is realized, as shown in Figure 3.

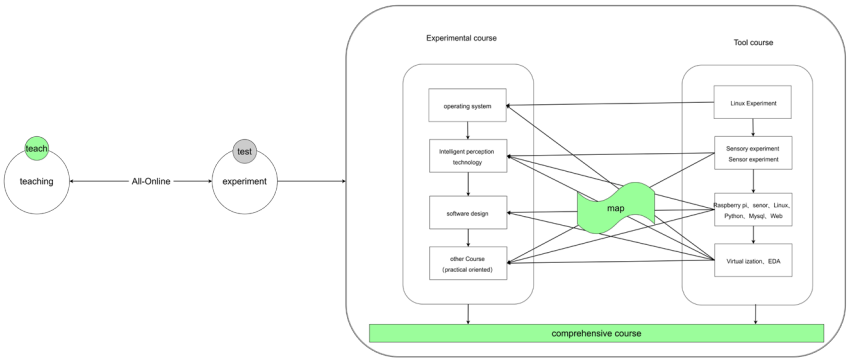

Figure 3: The mapping model of curriculum group and experimental group under the "All-Online" concept

(2)Deeply study the "All-Online" concept, innovate teaching experiment methods and improve teaching level

The post-epidemic era brings college teachers thinking not only online and offline, but also how to break through the fixed thinking mode in talent training, innovate teaching experiment methods, and guide and cultivate students' real autonomous learning ability. In the future, the concept of "All-Online" will be deeply rooted in the hearts of the people and strongly promote the full-time online model from college education, enterprise employment to lifelong learning. To this end, a student-centered full-time online driving model with the goal of "All-Online" is constructed, which integrates teaching modes such as cloud class and MOOCs to design new concepts and methods of experimental teaching with distinct characteristics and clear goals, and combines them with new ideas of training professionals of the Internet of Things to better improve teaching effects, as shown in Figure 4.

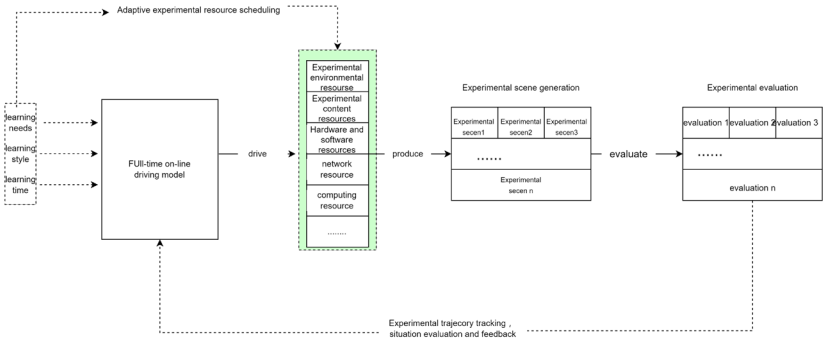

Figure 4: Full-time on-line driving model

(3)Transform and develop the experimental platform group of the integrated cloud Internet of Things, and create a new model of full-time online experiments

The online experimental teaching platform with traditional simulation technology as the core plays an important role in carrying out cognitive and basic teaching experiments. However, for the major of Internet of Things engineering, which focuses on real equipment and actual operating environment, it cannot meet the requirements of teaching experiments, especially when offline experiments are limited due to emergencies such as the novel coronavirus pandemic. Therefore, under the guidance of "All-Online" concept, with mapping relationship model and full-time online driving model as the core, and on the basis of existing experimental conditions, the integrated cloud Internet of Things experimental

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platform group is transformed and developed, and the key and difficult points of students' experimental learning are deeply explored through trace tracking and timely feedback is provided. In order to improve students' theoretical learning and experimental training effects, a new full-time online double closed-loop experimental teaching model of "All-Online" online and offline learning is formed, as shown in Figure 6.

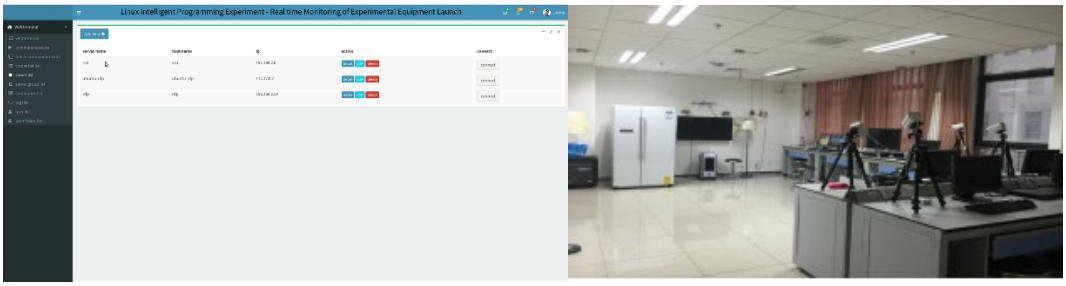

Figure 6: Internet of Things engineering integrated cloud Internet of Things experiment platform

4. Conclusion

With the background of the requirements of the construction of "new engineering", this paper starts from the discussion of the new model of engineering experimental teaching in the post-epidemic era, combines the characteristics of the Internet of Things engineering, adopts the Internet of things, Internet and other information technologies, and focuses on the top-level design on the basis of in-depth thinking and research on how to build the mapping relationship model between the curriculum group and the experimental group. The experimental management and development platform of the integrated cloud Internet of Things has been transformed and developed, the driving model of the all-time online experimental teaching has been built, and the difficulties in students' experimental learning have been deeply explored and fed back by using trace tracking, thus forming a new double-closed-loop experimental model of "All-Online" online and offline learning. At the same time, it actively introduces the actual needs and employment requirements of enterprises related to the Internet of Things, jointly discusses the construction of curriculum and experiment system, improves the "All-Online" concept and finally realizes the talent training goal of "teaching-reality-exercise-application-fine".

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