

Survey on Construction of Intelligent Adaptive Learning Platform in Ubiquitous Computing

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Abstract- *With the development of AI, 5G and big data technology, learning mode has gradually changed from traditional learning to ubiquitous learning (U-learning), which is a new learning paradigm that has been studied in recent years all over the world. Fully applying ubiquitous computing technology and building an intelligent online learning education platform to provide learners with powerful learning experience are the future development trend of intelligent learning. The concept of intelligent adaptive learning platform (IALP) is proposed based on the analysis of the shortcomings of existing platforms from a ubiquitous perspective. To sort out and outline the system architecture features and application functions of the intelligent adaptive learning platform can provide strategic thinking for relevant researchers to further clarify the implementation path of the intelligent adaptive learning platform. In the future, intelligent adaptive learning platform will play its advantages in precise learning, precise recommendation, precise evaluation and precise counseling, which will contribute to the current development of education informatization and intellectualization.*

Indexed Terms- *artificial intelligence, 5G technology, intelligent adaptive learning, ubiquitous learning*

I. INTRODUCTION

Ubiquitous Computing technology changes people's physical Ubiquitous computing technology changes people's physical environment and information environment, and integrates information space and physical space. Ubiquitous computing technology changes the traditional computing and information service model and constructs an environment full of computing and communication capabilities. In this space full of computing and communication

capabilities, people can freely access any information, computing, communication, entertainment and other services they need anytime, anywhere. As a result, a new learning concept, ubiquitous learning, has come into people's vision. Ubiquitous learning has become the focus of attention and research in the field of educational technology for a long time in the future, and is considered as the mainstream learning method in the future [1]. The Outline of the National Medium- and Long-Term Education Reform and Development Plan (2010-2020) clearly points out that "information technology has revolutionary influence on education development and must be attached great importance", and puts forward the strategic objective of "basically realizing education modernization, basically forming a learning society, and entering the ranks of powerful human resources countries" by 2020. Therefore, it is particularly important and urgent to further tap the ubiquitous learning potential under the support of computer technology and build an intelligent adaptive learning platform. The most famous learning platforms in the early foreign countries are resource online learning platform of Phoenix University [2], open university learning platform of Britain [3], Moodle [4] and Blackboard [5]. The early domestic online learning platform was represented by National Open Learning Network, Aopeng Learning Platform and Shanghai Learning Network [6]. Among them, National Open Learning Network and Aopeng Learning Platform mainly serve academic education, while the latter mainly serve lifelong learning. Since 2012, edX, Udacity and Coursera have sprung up rapidly in foreign countries, which has set off a global upsurge in online course learning, and has also led to the development of learning platforms such as Mocha China, Tencent Classroom and Sina NetEase Open Course. For example, our government and universities are actively promoting the construction of the MOOC Platform. The Ministry of Education and the Ministry of Finance have jointly supported the construction of the "Love MOOC" Platform, which is currently the

largest and most comprehensive online learning platform for courses in China [7]. In addition, other well-known MOOC platforms include "School Online" established by Tsinghua University in 2013, and "Good University Online" established by Shanghai Jiaotong University in early 2014, as well as "Wisdom Tree" and "Chaoxing Erya" and so on. Although the application of information technology has promoted the development of education informatization and made great progress in the construction of online learning platform, under the ubiquitous environment, the existing online learning platform still has the following shortcomings: First, the top-level design of the platform is inadequate. First, education authorities, schools and educational institutions lack overall planning for the construction of learning platforms, usually building multiple learning platforms in a region; secondly, learning platforms are self-governing; finally, because different platforms are developed by different companies, even though each platform provides interfaces, the systems developed by different companies are different. Data patterns, data standards and field designs are quite different, which hinders data flow artificially and makes statistical learning behavior data difficult to realize data mining and data analysis functions. Second, the learning experience of the platform is not strong. Although AR and VR technologies have been applied to education field for a long time, it is difficult to apply them to the real world because of the large amount of modeling data. Especially on the current learning platform, there are fewer learning contents using AR and VR technologies, and learners feel alienated from virtual scene learning. They can not observe, operate and practice repeatedly, which leads to learning. Moreover, the platform lacks the record of learners' learning growth. For example, the platform lacks the record of learners' learning goals, learning behaviors, learning steps, learning outcomes and learning reflection in the learning process, and can not achieve the tracking, analysis and prediction of learning, as well as the learning of learners. The visualization of growth records makes it impossible for learners to experience their own learning and growth intuitively. Thirdly, the intelligent service of the platform is not enough. Firstly, the existing learning platforms usually include the basic functions of course selection, course presentation, course learning and online interaction, but they lack the

learning service function supported by intellectualization. The resource service mode of the platform is mainly to support learners to find learning resources, and in order to find resources, learners usually need to operate cumbersome directory positioning to find the corresponding learning resources, so the personalized knowledge service level of the platform is low, and the convergence of resources of other websites is even less; secondly, learning. Learning content presents in a single form, the platform or text-based presentation of learning content, or video-based presentation of learning content, the lack of short and concise micro-lessons and difficult questions and answers resources, but also the lack of knowledge map type resources to show learning content. Fourth, the platform's ubiquitous support is inferior. The most basic function of online learning platform is to achieve "everyone, everywhere, time" learning. Most of the existing platforms are Web-based web-based learning platforms, which are difficult to meet the needs of learners in mobile environment to acquire knowledge using fragmented time. In conclusion, the existing learning platform can not meet the learning needs of learners in the ubiquitous environment. We need to use ubiquitous computing technology to build an intelligent adaptive learning platform with simple interface, user-friendly, explanatory, timely response and high security, so as to meet the needs of learners in personalized learning under the intelligent environment, serve the whole people's learning and promote educational equity.

II. UBIQUITOUS COMPUTING AND UBIQUITOUS LEARNING

A. Ubiquitous Computing Ubiquitous computing is the "third generation" computing technology after mainframe and personal computer. In the past 50 years, the development of computing technology has gone through two stages: one is the era of mainframe, in which many people share a computer; the other is the era of personal computer, in which one person and one machine are used. Today's internet will take us from a wide range of distributed computer systems to the ubiquitous computing age. In the era of ubiquitous computing, one person and many computers can be realized. In early 1988, the Xerox PARC Computing Science Laboratory (CSL), headed by

Mark Weiser, began its research on Ubiquitous Computing (UC). In 1991, Mark Weiser formally proposed the concept of ubiquitous computing in "The Computer for 21 Century" [8], later known as Pervasive Computing (PVC). In 1999, the first Ubi-comp International Conference was held, and in 2000, the first Pervasive Computing International Conference was held. In 2002, the IEEE Pervasive Computing Journal was launched. PARC's UC program was originally designed to solve some fundamental problems of personal computers: too complex to use; too demanding people's attention; too isolated from other people and real activities; too dominant over people. Ubiquitous computing strives to put the computer back where it should be: repositioning in the context of the environment, focusing more on human-to-human interaction, rather than human-to-machine interaction. The concept of ubiquitous computing emphasizes the integration of computing with the environment, while the computer itself disappears from people's sight. Under the ubiquitous computing model, people can acquire and process information at anytime and anywhere. In other words, in the ubiquitous computing mode, computers will become methods that do not require people to pay attention to them. Like water, paper and pen, they have been naturally embedded in our living environment, which makes us pay more attention to the tasks we need to accomplish, rather than the operation of computers.

- B. Ubiquitous Learning As for ubiquitous learning, it has many names, such as seamless learning, universal learning, ubiquitous learning and so on. There are many opinions about the definition of learning at home and abroad, but there is still no accepted and easy-to-understand concept. In 2007, "China's Audio-visual Education" made two themes on "1:1 digital learning". Ubiquitous learning is defined as [9-10]: Ubiquitous learning is the future learning mode in pervasive computing environment. It is a way for anyone to obtain any information needed at anytime and anywhere. It is also a way to provide students with a scientific and technological tool available at anytime and anywhere. Learning activity 3A (Anywhere, Anytime, Any Device) learning. Ubiquitous

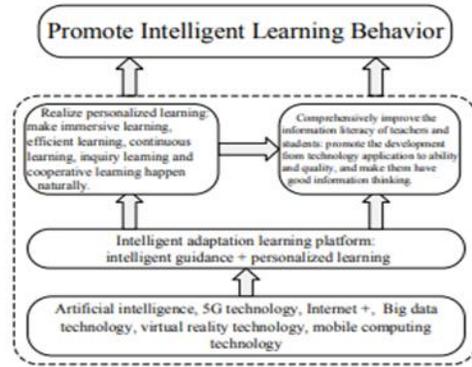
learning is an intelligent learning environment in which learners can use terminal devices to acquire learning content regardless of time and place, and information can be presented to learners in some way on their own initiative. It includes two meanings [11]: one is that this learning method can be embedded in people's daily life, if you want, you can take out from your pocket, schoolbag or the clothes you wear to learn; the other is that this digital device is a special computer technology, it is not me. The common desktop architecture is an embedded device. Ubiquitous learning in ubiquitous computing environment is in the space of integration of information space and physical space, and the occurrence of learning, learning needs and learning resources are everywhere, so learners can get the support of ubiquitous computing environment at anytime and anywhere. Ubiquitous learners use PDA (Personal Digital Assistant), smartphone, laptop and other mobile devices with communication interfaces such as RFID (Radio Frequency Identification), infrared data communication ports, Bluetooth ports or GPS cards, using wireless communication technology, anywhere. Learn anything you are interested in at any time

III. CHARACTERISTICS AND FUNCTIONS OF IALP

- A. Characteristics of IALP IALP is based on ubiquitous technology to rebuild the original platform, based on modern teaching theory, social learning theory, wisdom education theory, new constructivism learning theory, etc. It takes learners as the center, dynamically identifies learners' cognitive ability, learning style, learning state and learning culture, and realizes learning resources. Individualized recommendation of learning path and intelligent, fast and comprehensive data analysis, to match the media, resources, tools, teachers, students and other components of the learning space based on large data intelligence, so as to achieve the goal of intelligent seamless learning. Compared with existing learning platforms, IALP has the following characteristics: First, more intelligent applications. Using AI technology, learners can quickly present what they have learned and get

personalized learning content recommended by intelligence; when learning encounters difficulties, the platform can answer intelligently and realize "one-to-one" virtual tutoring; according to the learning situation of learners, the platform carries out periodic analysis, gives appropriate learning paths, and promotes learning. The rapid growth of learners makes learners feel more and more "understand you" on the platform. Second, richer content. By using AI, 5G, AR and VR technology, the original learning content based on text, image and audio-visual resources can be changed into AR and VRbased presentation, which makes the learning content more rich, realistic and easy for learners to master. Third, a faster response. Because of the high speed and low latency of 5G technology, learners can quickly upload and download learning resources; quickly connect online and offline resources or tools; quickly help learners to achieve precise learning content positioning, exclusive in-depth guidance, personalized learning path tracking and other behaviors. The application of AI, 5G, AR and VR technology makes the design of the platform beautiful and popular, easy to operate; the learning resources present a combination of virtual and real, smooth and natural; the platform's intelligent services such as resource search, resource recommendation, intelligent question answering, augmented reality, virtual reality are "moistening things silently".

B. Functions of IALP The goal of IALP is to focus on such problems as lack of learning sustainability, lack of learning experience, lack of learning inquiry, inadequate data collection and data analysis in the process of lifelong learning. The purpose of IALP is to promote the application of AI in the whole process of teaching and to establish learner-centered online learning space for learners. For accurate education services, the realization of its function is shown in Fig. 1.



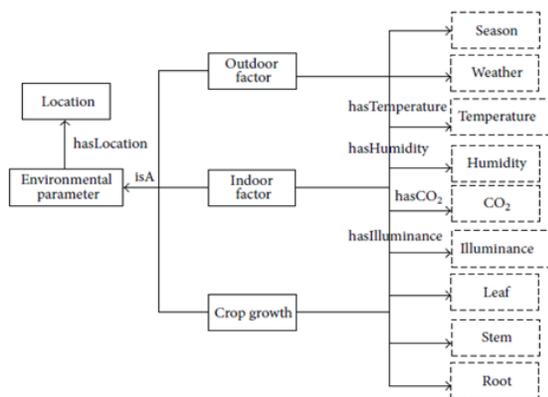
IV. IALP FUNCTIONAL FRAMEWORK (1)

Intelligent fusion function. Firstly, using AI technology, IALP can realize the data presentation of learning process. For example, through the application of machine learning, data mining and association analysis technology, it can track and record learners' data in online classroom learning, test questions, resource browsing, online interaction, group collaboration and inquiry learning. Secondly, using 5G and VR technology, IALP can provide teachers with flexible and convenient design of teaching process, realize the functions of curriculum resource combination, presentation of learning content and evaluation of learning; moreover, IALP can identify learners' learning activities, learning partners, learning sites and learning time. Meanwhile, it provides platform support for the development of online teaching and learning, and continuously promotes the intelligent integration of AI, 5G, VR and the whole process of teaching. (2) Intelligent interconnection function. Through ubiquitous computing technology, IALP achieves meaningful interconnection of learning content, generates explicit and implicit intelligent learning paths and diversified learning tools and learning scenarios, provides learners with learning content and media tools suitable for their own development, and enables learners, learning resources and learning tools to form interconnection and make learning possible. The learners have the intimacy of "platform knows me", immersion and experience of "platform knows me", which promotes learners' individualized learning and makes immersion learning, efficient learning and continuous learning happen naturally. (3) Intelligent analysis function. Applying ubiquitous computing technology, IALP can realize intelligent, fast and comprehensive data

analysis, reveal the relationship between learning data and teaching information, and make learning prediction and service on this basis, so as to achieve the purpose of improving teaching and learning effectiveness. Data mining technology is used to organize, record and clean learners' video learning time, text learning time, resource browsing quantity, homework completion, participating test results, number of forum speeches, Internet learning time, mobile Internet learning time, online learning time, and learning resource categories. Online learning process prediction model is helpful to promote the formation of online learning achievement prediction, academic early warning and process evaluation.

V. CONSTRUCTION OF IALP

A. Construction of IALP System The design of IALP needs to adapt to the development of ubiquitous computing technology, satisfy the new requirements of intelligent learning serving the whole space, all time and all audiences, aiming at enhancing the effect and efficiency of knowledge transmission, ability training, quality improvement and thinking expansion, so as to meet the needs of autonomous learning, the learning habits of learners and guide correctly. Learning direction and promoting continuous learning are the conditions for implementation. Therefore, based on the analysis of the direction and objectives of IALP construction, we design the architecture of IALP construction system, as shown in Fig



2. 2. Architecture of IALP system P

PIPlatform application layer. Cloud teaching, cloud learning, cloud community and cloud management in platform application layer mainly provide interactive interface for learners, teachers, assistants and managers. Cloud teaching serves online teaching on the platform. Through the platform, learners and teachers can carry out simultaneous classes in different places, realize the function of multi-place and multi-person sharing the same course, and transmit the teaching content to many learners in time to overcome the shortage of teaching sites and teachers. Cloud learning is the core function of platform design. Through unified identity authentication, the platform provides learners with "tailor-made" learning content to meet learners' learning needs at anytime and anywhere, and provides precise services such as learning progress, learning assistant resources and learning arrangements to achieve personalized learning. The cloud community can realize online interactive functions, including learning circles, students and friends. Blocks such as group, class group and discussion group are mainly oriented to the interaction between learners and learners, learners and teachers, learners and technicians. Cloud management can provide management controls to help administrators, teachers and learners manage their business separately, so as to realize the whole platform such as "running cloud and running water". General operation and presentation. (2) Platform data layer. The main functions of the platform data layer are as follows: firstly, it is responsible for providing data sources to users, including user information databases such as learners, teachers, managers, learning behavior databases, teaching databases, learning resource databases, etc. The platform extends these databases to mobile information base, mobile learning resource base and large data field attributes, so that these databases have the functions of centralized storage, management and calculation. The database is backed up from time to time, and the data is applied to other application systems to realize deep data mining and high data sharing. The second is to collect, collate, clean, naturalize and store learning process data, teaching process data, learning resources production data, interactive data, etc., to provide large data support for upper data analysis.

(3) Platform analysis layer. Data analysis and processing is a necessary process to realize

personalized learning. Therefore, the application of clustering technology, mining technology and analysis technology to calculate and analyze data is an indispensable function of the platform. IALP has a strong ability of data pre-processing and data analysis. By analyzing learners' personal information, learning process data, interactive process data and teachers' teaching data, service support data, it can provide close-fitting services for learners and teachers. The cloud community Teachers' guidance adjustment making optimization Data analysis and mining recommended intervention learning bearing choose Teach wisdom tutoring monitoring regulation Learn big data communication Analysis Learning resources Network learning space Virtual assistants Learners Supervise and urge Wisdom engine Fig. 3. Architecture of IALP network learning space

(4) Learning space layer. Learning space (abbreviation of network learning space) is a virtual space constructed by using information technology and intelligent technology to support formal learning and informal learning. It is an online learning field for learners. Through information technology and intelligent technology, Individualized learning space can be designed flexibly according to different learning styles of learners. With the growth of learners, the growth of learning resources and the new application of technology, learning space can be updated dynamically. (5) Resource tool layer. Resource Tool Layer mainly provides relevant materials and tools for teachers to design learning content and make micro-lessons. It also provides support tools and resources for learners to experience, understand, perceive and explore knowledge learning. It also provides online virtual simulation experiments for learners, so as to facilitate learners to deeply understand curriculum knowledge and improve practice. Operational ability. The virtual assistant in this layer can communicate and communicate with learners. It can not only solve the loneliness of online learning, but also replace teachers to answer questions and solve puzzles for learners. (6) Balanced development layer. Balanced development layer is a virtual space that provides knowledge acquisition, experience sharing and talent display for all users to grow in an all-round way. Learning Star is a place for learners with hard working habits, persistent quality, flexible and meticulous thinking to show their learning

experience and achievements; reading library provides learners with a wide range of online ebooks, provides intellectual support for the cultivation of deep thinking ability of learners, and improves the stickiness of IALP. B. Construction of Learning Analysis Model in Ubiquitous Environment Compared with previous analysis models, learning analysis in ubiquitous environments has the characteristics of high speed, high capacity and low latency. Using 5G and machine learning technology, the platform can effectively calculate and mine large learning data, complete six steps of data acquisition, data collation, data cleaning, data analysis, data presentation and structure feedback, thus realizing the construction and operation of learning analysis model. A goal-based learning model of service-oriented architecture is shown in Fig. 4. Personalization intervention engine managers Teachers' Learners' Collaborative learning Learn information Learning progress Learning preferences Study partner Learning culture Learning professional Technical literacy The learning time Cognitive level Knowledge points Practice test Micro lesson video Case interpretation Virtual experiment Secondary data Learning content Data visualization The data processing The data analysis AI+5G Intelligent prediction model.

CONCLUSION

The Action Plan of Education Informatization 2.0 issued by the Ministry of Education in April 2018 points out that by 2022, the development goal of "three-all, two-high and onebig" will be basically realized, that is, teaching application will cover all teachers, learning application will cover all school-age students, digital campus construction will cover all schools, information application level and information literacy of teachers and students. All over the world to build a platform for "Internet + education". On the basis of "classroom use, social use, frequent use and universal use", the construction of IALP can promote the deep integration of information technology, intelligent technology and education and teaching, realize flexible, investment, easy and effective learning, and provide convenient, timely communication and other functions. This will help to improve learners' information literacy in an all-round way, and promote learners' information literacy from the application of information technology to the

expansion of their ability quality, so as to enhance their information value judgment and information thinking ability. At the same time, the construction of IALP can also provide complete instructional design and unique resource presentation, so that teachers can use information technology or tools to solve curriculum design, teaching process optimization and resource design problems, and thus improve teachers' information literacy.

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