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Development of Elderly Smart Education Courses: A Case Study of Home Plant Health Care

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Abstract

The offline course "Home Plant Health Care," which is available to the senior population, serves as the study object for this paper. Learn how to use artificial intelligence technologies to transform it from a face-to-face education to a smart course. Give other examples of how AI technology is being used in elder education.

Keywords

Elder Education, Smart Education Courses, Knowledge Graph

1. Introduction

As the world's population ages more quickly, elder education's societal worth as a crucial component of the system of lifelong learning has grown in importance. The rate of aging in China is exceptionally high. In order to improve older people's quality of life, social engagement, and mental health, it is now crucial to support the growth of elder education.

One of the most important forces behind educational reform is intelligence. In order to support the holistic development of humans, intelligence opens up countless opportunities for the organic blending of cultural and scientific education. According to Huai Jinpeng, who spoke at the 2024 World Digital Education Conference, "implement AI-enabled actions, actively promote wisdom to help learning, teaching, management, and research, and provide effective action support for developing a learning society, smart education, and digital technology".

Given this, it is worthwhile to investigate a number of difficulties. For instance, how to use digital technologies to give senior citizens more flexible and easy learn-

ing options, encourage their curiosity, and improve their capacity to adjust to digital technology.

Home Plant Health Care is an offline course. The course is relevant to senior citizens' daily life and is intended for older students who enjoy greenery and wish to build a healthy home environment. The course teaches students how to choose common houseplants, how to care for them, how to control pests and diseases, and how to value the environment. Older students learn the rules for caring for major local houseplants, the different types of pests and diseases, their patterns of occurrence and development, and effective control measures; they master the rational and safe use of pesticides; and they begin to develop the ability to discover, analyze, and solve practical gardening problems at home.

This study will use this course as a research subject to investigate how artificial intelligence technology can transform it into a smart education course that caters to the learning patterns of the elderly.

2. Framework

2.1. A Knowledge Graph Makes Knowledge "Visible" and "Clear"

Breaking with standard course arrangement and creating a hierarchical "knowledge point-course knowledge graph" paradigm. Mark the linkages between knowledge points, recombine course teaching resources based on those knowledge points, and create a visual course knowledge graph.

2.2. AI Makes Learning Smarter

AI technology into the curriculum to provide AIGC (AI-Generated Content)-based services such as course content iteration, teaching technique reform, teaching evaluation optimization, intelligent teaching assistants, intelligent teaching management, and intelligent learning companions. Comprehensively promote the implementation of AI application scenarios such as helping learning with intelligence, teaching with intelligence, management with intelligence, and research with intelligence. Promoting the curriculum for the "Smart+" era.

3. Principles

Instructional Effectiveness: The goals of instruction are precise, targeted, and in line with the cognitive styles of the pupils. Be able to incorporate inspiration, imagery, and subsidiarity into AI Agent's instruction. Achieving exceptional outcomes while adjusting to the demands of teaching and learning. It may fully encapsulate the benefits of smart education teaching and fill the gaps left by traditional teaching techniques.

Scientificity: There are no political or scientific flaws in the teaching's substance, which is accurate, rational, and understandable.

Intellectuality: With intelligent adaptability, multi-dimensional interaction, and data-driven. Personalized learning resource suggestions, intelligent Q&A, learning analysis, knowledge graph, and other features may be offered to both teachers and

students.

Elderly-oriented: Topic selection, pedagogical design, and curriculum implementation should all reflect the human-centered philosophy and help to promote a "age-friendly" society.

4. Contents

4.1. Building a Knowledge Graph

4.1.1. Knowledge Graph Architecture

A knowledge graph is defined as "a graph of data intended to accumulate and convey knowledge of the real world, whose nodes represent entities of interest and whose edges represent potentially different relations between these entities." (Hogan et al., 2021). Three layers make up the architecture of the knowledge graph: data, model building, and application. Textbooks, syllabi, course videos, and extension resources are among the content support services offered by the data layer for creating the course knowledge graph. The model-building layer provides technical aid in the construction of the curricular knowledge graph. The teaching resources are extracted from the course knowledge extraction, known as entity recognition, entity relationship recognition, and so on, to obtain the knowledge points contained in the course as well as the relationships between the knowledge points, which form the knowledge point layer of the course knowledge graph. On the other side, the application layer for learners and teachers comprises knowledge graph display, knowledge point querying, knowledge graph updating and extension, and video punctuation and slicing.

4.1.2. Knowledge Point Planning

A knowledge point is the fundamental unit of instructional activity for conveying instructional content. This renders the knowledge graph both subjective and objective. Subjectivity is defined as the compilation of knowledge points that should support the actual teaching and learning activities while also aligning with the teacher's teaching principles. Objectivity comes from the notion that a knowledge graph should reveal the course's fundamental logical structure, which is dictated by the knowledge itself.

1) The quantity and content of the knowledge points.

If there are too many knowledge points, the graph will become overly complex. This raises the cost of using and understanding for teachers and students, as well as the difficulty of precisely matching with other curriculum resources, such as videos and extension materials. As a result, this course decided that the amount of knowledge points in the atlas should not exceed 200, while taking into account the demands of older people.

2) Knowledge points naming.

Knowledge points naming adheres to the principles of clarity and correctness, ensuring that each node name intuitively reflects the notion or thing it represents while avoiding ambiguities. At the same time, a combination of specialization and popularity is examined, and explanations are provided as needed to help students

understand.

3) Classification of knowledge points.

Taking into account the actual needs of home plant health care and the students' use scenarios, the knowledge points can be classified into five groups. The first category, Insect Basics, teaches students about the basic characteristics and classification of insects, as well as the fundamentals of pest identification and management. It discusses the exterior morphological qualities of insects, as well as their biological attributes and classification. The second category, Pest species and Characteristics, teaches students how to swiftly recognize different species of pests and how they cause damage, laying the groundwork for precision control. It addresses common leaf-feeding, sap-sucking, and boring pests. The third category, Disease fundamentals, teaches students about the causes and transmission mechanisms of plant diseases, as well as providing a theoretical foundation for disease prevention. It discusses the fundamental ideas of disease, invasive disease pathogens, the infestation process, and the infestation cycle. The fourth category, Common forms of diseases, assists students in identifying various types of diseases, understanding their features and hazards, and targeting prevention and control through practical examples. Covers common fungal, bacterial, and viral illnesses. The fifth category, Pest Control Techniques, offers users particular control tactics and approaches to satisfy their practical demands. Discusses pest control ideas and practices.

4) Knowledge points teaching goal setting.

In the cognitive domain, the main objective of teaching is to help students gain knowledge and improve the ability to apply it to rational and orderly thinking. This course has three objectives: to learn the fundamentals of insect identification, diseases diagnosis, and integrated pest management, as well as various methods of control for home garden plant diseases and pests.

4.1.3. Knowledge Graph Construction

1) Knowledge graph framework construction.

We organize the curriculum's teaching subjects and extract the knowledge points under each topic using the curriculum framework, which combines the teaching objectives and knowledge mapping design planning. Taking the chapter "Common Virus Diseases" as an example, the goal is to understand the symptoms of main virus illnesses, pathogens, the infestation cycle characteristics, morbidity circumstances, and control strategies. Creating a control scheme based on the disease pattern is challenging. Teaching topics include cruciferous vegetable virus diseases, melon crop virus diseases, tomato and potato virus diseases, and apple mosaic disease. This chapter's teaching theme is organized on the teaching content, pathogen characteristics, symptom recognition, transmission pathways, and prevention and control techniques for systematic combing. Each teaching theme covers four categories of knowledge: pathogens, typical symptoms, transmission pathways, and preventative and control strategies. For example, **Table 1** displays the knowledge points on Apple Mosaic Disease.

Table 1. Apple Mosaic Virus (ApMV) - Key Knowledge Points

Teaching Theme	Apple Mosaic Disease
Pathogen Type	Apple Mosaic Virus (ApMV)
Typical Symptoms	1) Yellow mottling or ring patterns on leaves 2) Severe cases: Leaf drop, smaller fruits
Transmission Pathways	1) Grafting (primary route) 2) Dodder (Cuscuta spp.) 3) Contaminated tools (e.g., pruning shears)
Control Methods	1) Use virus-free scions for propagation 2) Remove and destroy infected trees promptly 3) Improve tree vigor (e.g., organic fertilizers, proper pruning)

2) Setting knowledge points attributes.

Add type labels (focus, difficulty, test, customisation) and cognitive dimension labels (memorization, understanding, evaluation, creation) to knowledge points based on the demands of the teaching application. Type labels assist students in swiftly identifying the course's key information, which must be prioritized and mentally prepared in advance to avoid blind learning and save time. Cognitive dimension labels give students distinct learning objectives and difficulty gradients. As they gradually go from the "memorization" phase to the "evaluation" or "creation" dimension, students may experience how their skills and knowledge are growing, which boosts their enthusiasm to study and sense of accomplishment.

3) Constructing knowledge points relationships.

The foundation of building a structured knowledge network in a knowledge graph is the type of relationship between knowledge points; various relationship types might show the application, hierarchical, or logical linkages between knowledge. For example, the genus "Apple mosaic virus" is a "plant virus"; causative relationships, "apple mosaic virus" causes "yellow mottling"; control step, "selection of resistant varieties" takes precedence over "chemical control," etc. The relationships between the knowledge points in the dispersed state are labeled and associated, and eventually presented in a tree structure, which ultimately generates a complete knowledge map of a course.

4.1.4. Target Graph Construction

Curriculum and instructional objectives are important parts of the educational process. They oversee curriculum design and instructional activities while also providing criteria for evaluating student learning outcomes. In addition to assisting teachers in assessing students' performance on various objectives and competency dimensions in order to adjust the level of teaching objectives and the difficulty of teaching content on time, creating a target graph of course objectives can more accurately depict the learning portrait of older people. The selection of knowledge points is critical to the target graph. By assessing the course's overall educational objectives, relevant knowledge points that directly contribute to ac-

complishing the instructional objectives of each lecture are selected and organized.

4.1.5. Problem Graph Construction

The course "Home Plant Health Care" is hands-on and practical. During the learning process, students frequently run into a lot of real-world issues. If students' queries are connected to the knowledge points and then distilled, it will be possible to successfully integrate academic knowledge with practical application. This course is designed using a problem graph that comprises regular, difficult, and combined problems to help students apply what they have learned.

4.1.6. Graph Resource Linking

You can mark the knowledge points alongside the resources that were sorted out early in the process after the knowledge graph is constructed. Finalize the knowledge graph's resource binding. This is in advance of the learning data being counted from the teaching resources and added to the knowledge graph. You have two options: either click on each knowledge point in the knowledge graph and choose the resource that corresponds to it, or click on each resource in the course materials and chapter content and choose which knowledge points need labeling.

4.2. AI Agent Construction

Since the BERT model came out, artificial AI agents have developed further and realized their full potential in a variety of industries. There have been three evolutions of AI agents. Big language models or multimodal big models are more frequently the foundation of what we currently refer to as AI agents. Large-model multimodal content understanding and generating skills may be more effectively unleashed and applied by such AI agents, which will hasten the significant transformation of numerous sectors. Taking the field of education as an example, the use of AI agents not only reimagines how instructors and students access and engage with the learning materials, but it also places the user at the center and greatly enhances the convenience of campus life and the effectiveness of teacher and student information access.

The development of a large model-based intelligence for elderly courses must include modules for reasoning, learning, and execution, all supported by a technical pedestal. As seen in **Figure 1**, the course "Home Plant Health Care" primarily consists of three layers: an application layer, a functional module layer, and a technology layer.

4.2.1. Technology Layer

Natural Language Processing, "a field of computer science, artificial intelligence, and linguistics concerned with the interactions between computers and human (natural) languages (Jurafsky & Martin, 2000)." Machine Learning, "evolving toward deep learning, where models learn hierarchical representations from raw data (LeCun, Bengio & Hinton, 2015)." Recommender System, "filter vast amounts of information and help users discover content they'd like (Koren et al., 2009)."

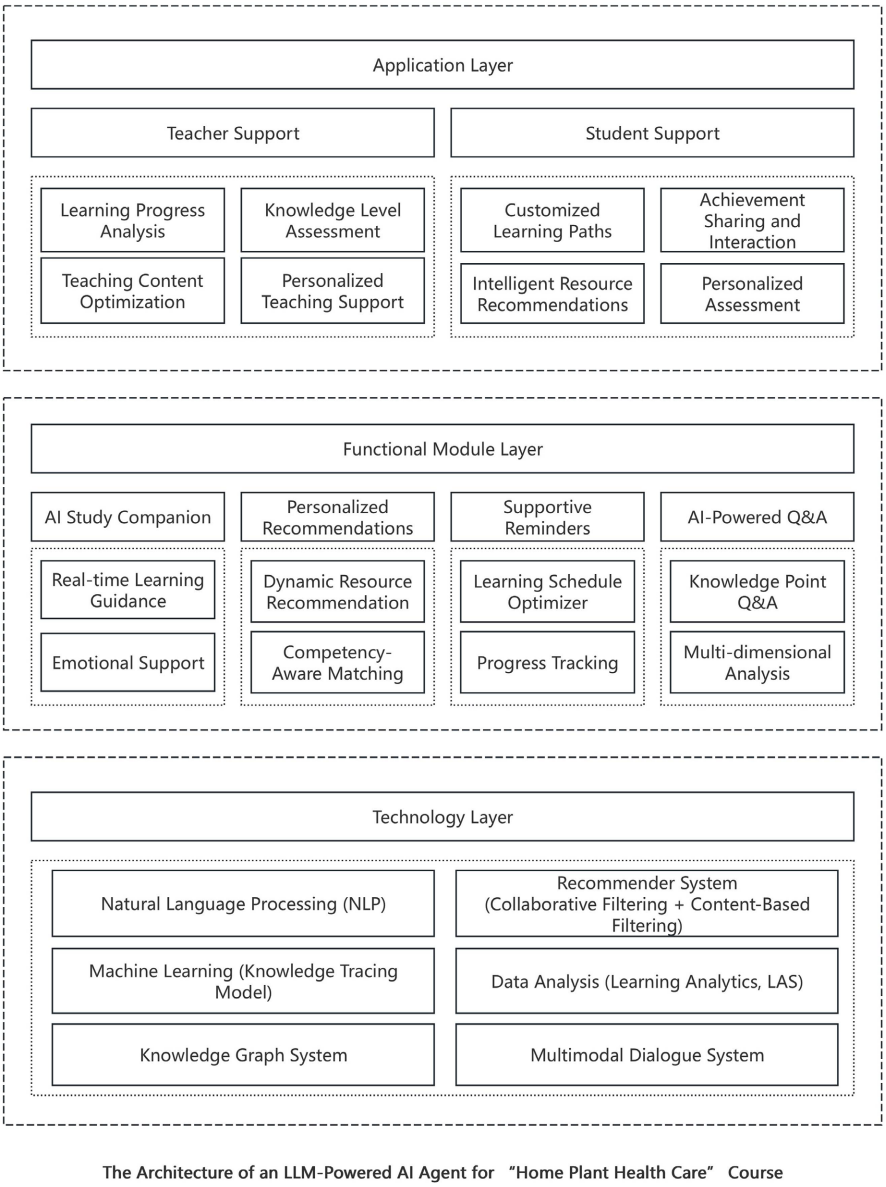

Figure 1. The Architecture of an LLM-Powered AI Agent for "Home Plant Health Care" Course.

Data Analytics (Learning Analytics LAS), "uses data generated by learners' interactions with digital systems to understand and improve learning (Ferguson & Clow, 2017)". Knowledge Graph System, "large-scale, structured knowledge base that integrates information extracted from multiple sources, enabling applications like search, question answering, and recommendation (Dong et al., 2014)." Multimodal Dialogue System, "scalable conversational agents that handle domain-specific knowledge across text, vision, and other modalities, using techniques like knowledge graph integration for grounded responses (Saha et al., 2018)." They are all included in this module, which is the foundation for building AI agents.

The participant's queries are parsed by natural language processing, which also extracts keywords and purpose. Supporting students in posing text or voice que-

ries and responding to them in a multimodal format (text + image, for example) is the responsibility of the multimodal dialog system. In order to help with question answering or suggesting pertinent knowledge points, the knowledge graph system is in charge of offering an organized representation of subject knowledge. Based on the student's learning history and interests, the recommendation system is in charge of suggesting classes, subjects, or educational materials. Knowledge learning is in charge of evaluating students' acquisition of knowledge and forecasting their areas of weakness. Analyzing data on learners' learning behaviors and producing learning reports for instructors or students fall under the purview of data analytics. The specific structure is shown in Figure 2.

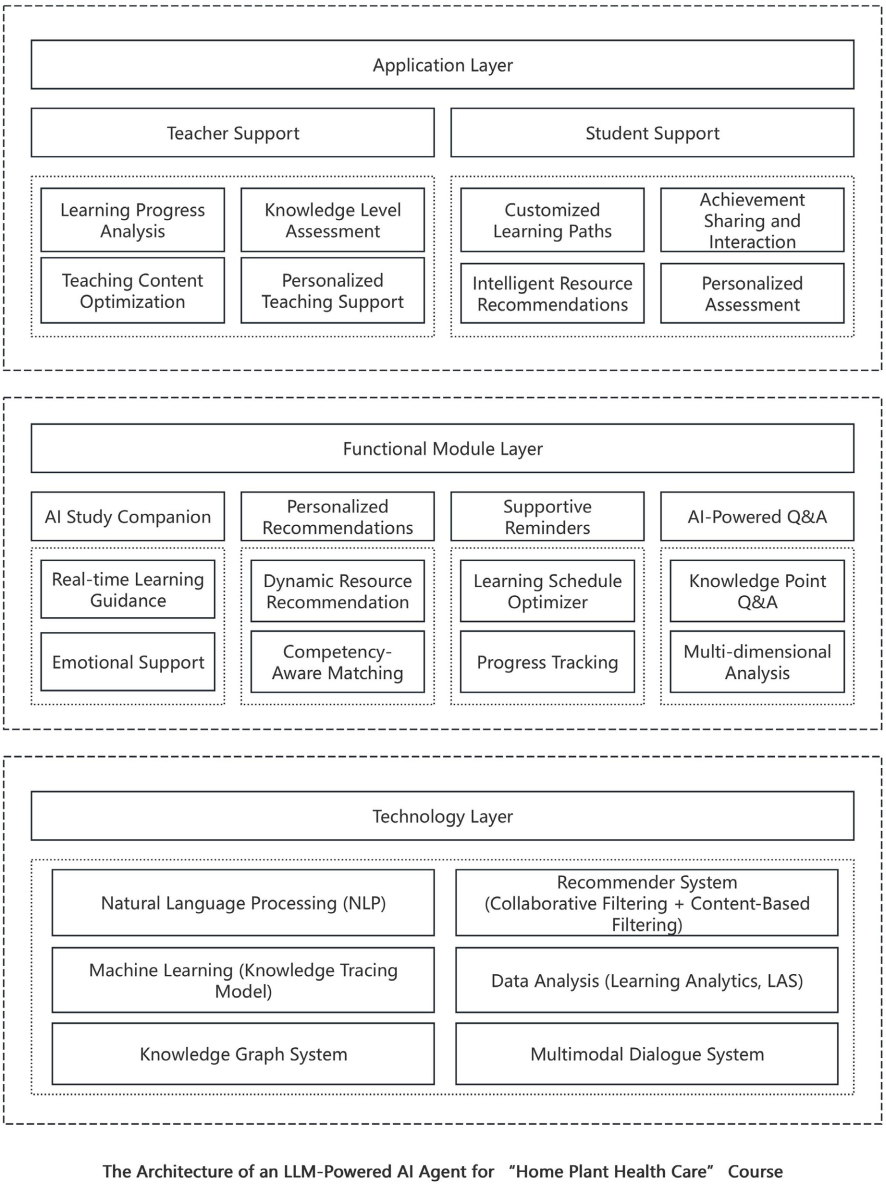

Figure 2. Technology layer architecture diagram.

4.2.2. Application Layer

The interface that instructors and older students use directly is known as the application layer. The main functions for teachers include: learning progress analysis, knowledge level assessment, teaching content optimization, personalized teaching support. Teachers can be helped to accomplish this: ① Collect data on students' learning behaviors, progress, and mastery. ② Use intelligent Q&A and individualized advice modules to identify knowledge deficiencies. ③ Customize teaching based on recommender system and Q&A data. ④ Offer individualized resource recommendations to support diverse programs. The main functions for students include: customized learning paths, achievement sharing and Interaction, intelligent resource recommendations, personalized assessment. Students can be helped to accomplish this: ① Personalized study program. ② Content tailored to your level of knowledge. ③ Regularly assess learning effectiveness and identify learning weaknesses. ④ Provide companionship and emotional value to older students by answering their questions, sharing what they know, and increasing their sense of accomplishment.

4.2.3. Functional Module Layer

The functional module layer is the module that implements all the core business logic. It includes ① AI study companion. Provide 24-hour learning support services, real-time student guidance, dynamic learning monitoring, emotional support for older students, etc. ② Personalized recommendations. Based on a student's learning situation, learning style, and learning interests, learning resources in a variety of media formats are intelligently recommended, the level of difficulty of the learning content is intelligently adjusted, etc. ③ Supportive reminders. Reminders for push learning programs are just one example. ④ AI-powered Q&A. Offers real-time replies based on subject matter expertise, assisting with conceptual explanations, debugging, and sample problem analysis while suitably directing the student's thought process.

5. Conclusion

Using an offline course as an example, this paper investigates the creation of smart courses in elder education and suggests a relatively novel technical approach to creating them. It will then investigate the application of smart elderly education courses in order to offer senior citizens more individualized, intelligent, and convenient high-quality educational resources.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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