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Exploring the Path of AIGC and AI Agents Empowering Front-End Teaching and Learning

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Abstract: In response to the pain points of rapid iteration of front-end education technology, large differences in learner foundations, and a lack of practical scenarios, this paper combines generative artificial intelligence and AI agents to analyze the empowerment logic from three dimensions: knowledge ecology reconstruction, cognitive collaborative upgrading, and teaching methodology innovation. It explores its application scenarios in teaching and learning, sorts out challenges such as technology adaptation and learning dependence, and proposes paths such as building an exclusive AI ecosystem and optimizing the guidance mechanism of intelligent agents to provide support for the digital transformation of front-end education.

Keywords: AIGC; AI intelligent agent; Front-end education; Teaching and learning efficiency

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1. Introduction

As the core of digital product interaction, the "cross-end compatibility and fast iteration" characteristics of front-end technology require high requirements for hierarchical guidance and scene adaptation capabilities in education. The current front-end education is facing three challenges: technology iteration (such as Vue3, React18) is faster than curriculum updates; The difference in learner foundation from "zero programming" to "engineering experience" is significant; and a lack of real development scenarios for enterprises. AIGC combines the dynamic decision-making and real-time interaction capabilities of AI agents to adapt to technology stacks and simulate development environments, providing solutions for solving problems [1]. This paper focuses on cross-level requirements and explores the collaborative application path of the two.

2. The core logic of AIGC and AI agent empowerment

2.1. Reconstruction of knowledge ecology

Traditional front-end education relies on static textbooks, making it difficult to keep up with the pace of

technological iteration. AI agents use domain knowledge graph construction technology to real-time crawl multiple resources such as MDN documents, framework official blogs, GitHub open source cases, etc., structuring knowledge points such as HTML5 new features, Vue3 Composition API, Uniapp cross-end framework, etc., forming a related knowledge network of "basic syntax framework application engineering practice performance optimization." For example, when React18 introduces concurrent rendering features, AI agents can automatically update their knowledge graph and associate it with the logical chain of "concurrent mode suspense component actual application scenario," ensuring that the adaptability of teaching content to industry technical standards is improved by more than 30%, effectively solving the problem of "learning application disconnect."

2.2. Cognitive collaborative upgrade

In front-end development, learners often feel frustrated due to a lack of direction in debugging, beginners are prone to getting stuck in grammar errors, while advanced learners need to overcome engineering difficulties. AI intelligent agents rely on real-time feedback engines to detect syntax errors and logical vulnerabilities through code static analysis techniques (such as Esprima parsing JS code), combined with natural language processing (NLP) to generate structured feedback of "error localization + principle explanation + optimization solutions"; Educators use the analysis of learning data output by AI agents (such as high-frequency error points and progress differences) to focus on higher-order thinking guidance (such as architecture design and user experience optimization), achieving a balance between "large-scale teaching" and "personalized guidance."

2.3. Methodological innovation

Traditional project-based teaching has problems such as vague requirements and insufficient resources. AI agents rely on scene generation technology to generate hierarchical project resources based on learner profiles [2]: providing "personal blog development" (with detailed steps and code comments) for beginners, and generating "e-commerce homepage + order management system" (including requirement documents, UI design drawings, and interface simulation data) for advanced learners; At the same time, through dynamic scenario iteration technology, real processes such as product managers proposing requirement changes and testing engineers providing bug feedback are simulated, allowing learners to hone their skills in simulating enterprise processes and shorten the "learning employment" adaptation cycle.

The core logic of AIGC and AI agent empowerment is shown in **Figure 1**.

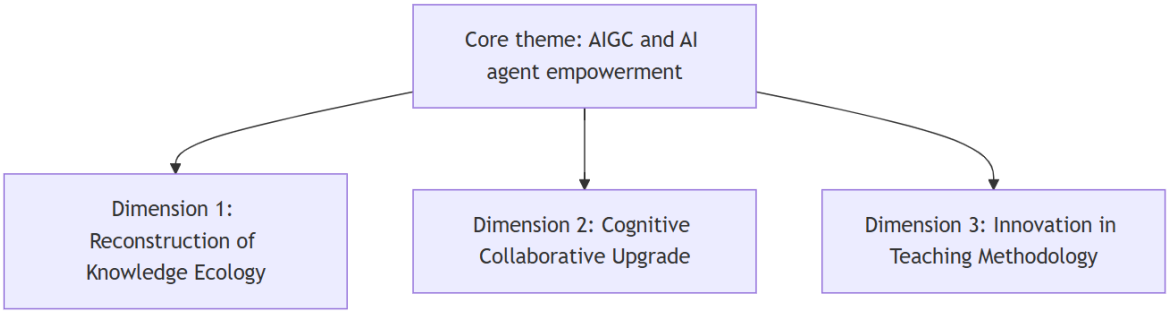

Figure 1. Core logic of AIGC and AI agent empowerment

3. Application scenarios of AIGC and AI agents

3.1. Teaching end: AI intelligent agent builds an efficient teaching system

3.1.1. Intelligent course design: Personalized algorithms support layered teaching

AI intelligent agents generate differentiated curriculum systems based on collaborative filtering and content analysis algorithms, combined with the needs of educational subjects: institutional education focuses on the system module of "HTML/CSS → JavaScript basics → Vue basics → TypeScript advancement," while vocational training strengthens the practical module of "engineering tools → cross-end development → performance optimization." When Vue3 becomes mainstream in the industry, intelligent agents can automatically add Pinia state management content and reduce outdated knowledge points of Vue2. Practice has shown that AI-assisted course design can reduce preparation time by 40% and improve course industry adaptability by 35%.

3.1.2. Real time teaching support

AI intelligent agents rely on multi-modal interaction technology [3] to support text, code, and visual interaction: theoretical course hierarchical analysis of "React-hooks"; The practical course identifies UI adaptation issues through screen sharing and generates modification suggestions; a 24-hour post-class response to compatibility issues has increased the efficiency of resolving learners' questions by 60%.

3.1.3. Automated evaluation

Building a multidimensional evaluation model for AI agents: detecting errors through syntax parsers, verifying page and design consistency through OpenCV, evaluating performance through Lighthouse, and generating reports such as "component reuse rate less than 30%"; Simultaneously analyze the entire dataset to identify high-frequency errors such as "JS asynchronous programming bias," forming a "evaluation feedback optimization" loop [4].

3.2. Learning end: Creating a self-directed learning path

3.2.1. Personalized navigation

AI agents generate dynamic portraits through user profiling technology, combined with entrance testing and learning behavior (homework time, error rate): recommending HTML/CSS visual tutorials for beginners and Vue3 source code analysis for advanced learners, ensuring that learners learn in the "zone of proximal development" [5].

3.2.2. Immersive project practice

AI intelligent agents simulate industry scenarios such as e-commerce and office, providing complete development resources: when developing blogs for beginners, guide "layout simple interaction"; When developing e-commerce systems for advanced users, solve the problem of "cross domain configuration state modularization"; After the project is completed, evaluate it from the four dimensions of "functionality specification performance," generate improvement plans such as "Vuex modular management," and accumulate industry experience.

3.2.3. Career empowerment

AI agents extract skill keywords such as "TypeScript" and "ECharts" from recruitment data to generate skill gap reports. According to career planning recommendations, simulating technical interviews and providing feedback

and answers to students can increase the employment matching rate by 28% and shorten the adaptation period for entry by 30%.

Application scenarios of AIGC and AI agents, as shown in **Figure 2**.

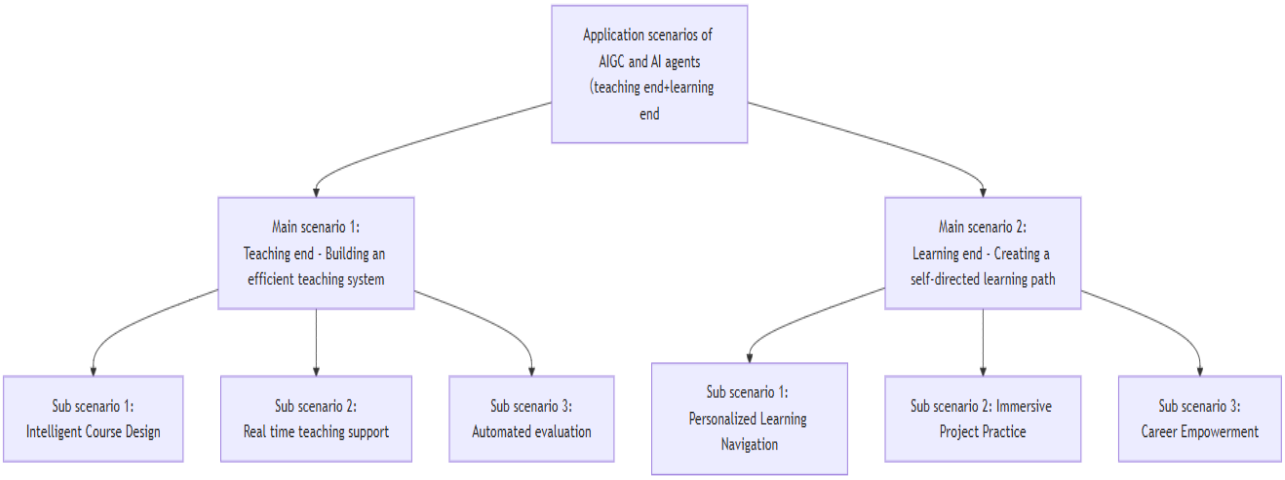

Figure 2. Application scenarios of AIGC and AI agent

4. Challenges in application

4.1. Insufficient technological adaptation

The generalization ability of AI agent algorithms is limited: the knowledge base lags behind technical iterations, and outdated solutions such as Vue2 may be recommended. Due to insufficient training data, support for niche technologies such as TailwindCSS advanced configuration and Vite plugin development is weak. Subjective content, such as visual interaction optimization, relies on the judgment of educators.

4.2. Learning dependency risk

Some AI agents directly generate complete code without breaking down the logic, leading learners to overly rely on and ignore the principles of component communication and engineering standards, making it difficult to cope with changes in enterprise requirements and code refactoring.

4.3. Shortcomings in the evaluation system

Intelligent agents can only accurately evaluate objective indicators such as syntax and functionality, making it difficult to quantify code readability (completeness of comments) and innovation (interaction design); Focusing on result evaluation and neglecting learning trajectories such as “debugging ideas” requires manual supplementation, which limits efficiency.

4.4. Resources and ethical risks

Small and medium-sized institutions lack high-performance hardware to support intelligent agents; Generating code may violate open source agreements, and there is a risk of data leakage, such as learner project code and learning trajectories.

The challenges in the application of AIGC and AI agents in empowering front-end education are shown in **Figure 3**.

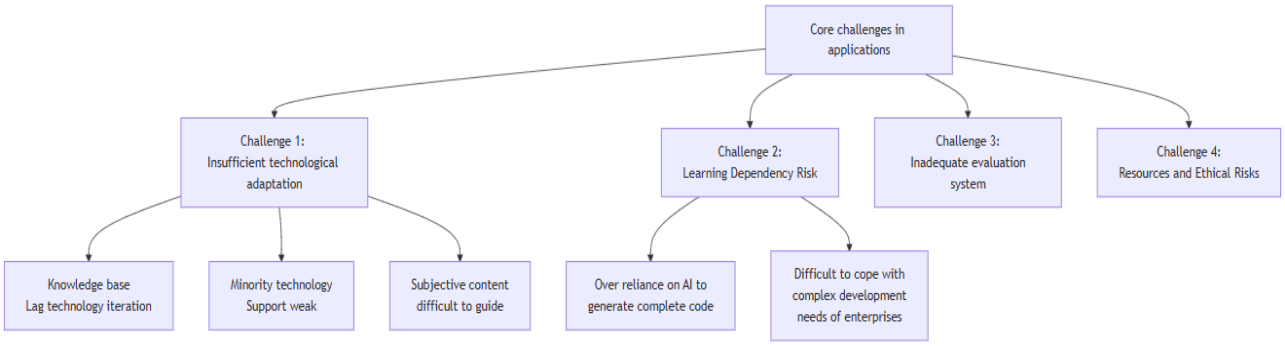

Figure 3. Challenges in AIGC and AI agent applications

5. Optimizing paths

5.1. Building an exclusive AI intelligent agent ecosystem

Collaborate with universities, enterprises, and communities to build a "big front-end AI data-set" (including enterprise code and technical documents), conduct domain pre-training on intelligent agents, and enhance support capabilities for niche technologies and visual interactions; Establish a "monthly update" mechanism to synchronize new framework features (such as Vue3.5 syntax sugar) with industry cases.

5.2. Optimizing intelligent agent guidance and permission control

Design the "AI-assisted + autonomous thinking" mode: restrict the generation of complete code through permission control, and only provide fragment prompts; Set up a 'no AI programming phase,' requiring independent completion of component encapsulation and state design; Strengthen the guidance mechanism, dismantle the logic of AI solutions, and encourage optimization and innovation.

5.3. Improving the intelligent agent evaluation module

Develop a subjective dimension evaluation module: introduce a code readability algorithm (based on annotation rate and naming conventions) and innovation indicators (interaction design differentiation); Add learning process evaluation, record debugging records, and combine educator ratings with learner peer evaluations to form a "result + process" evaluation system.

5.4. Promoting resource balance and ethical protection

The government provides lightweight AI intelligent agent cloud services (SaaS) to reduce institutional hardware dependence; Develop the "Code of Ethics for AI Intelligent Agents in Front-end Education," clarify the ownership of code copyright, and adopt data encryption to protect privacy; Carry out AI ethics education [6] to cultivate awareness of intellectual property and data security.

6. Conclusion

AIGC and AI agents effectively address the pain points of "content lag, insufficient layering, and weak practice" in front-end education through technologies such as knowledge graphs and real-time feedback. In the future, we need to address challenges by building exclusive ecosystems, optimizing guidance mechanisms, and adhering

to the principle of "technology empowerment + humanistic guidance," cultivating front-end talents that are suitable for the digital economy, and providing support for industry development.

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Disclosure statement

The authors declare no conflict of interest.

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