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Design Research on Gamified Teaching of Junior High School Information Technology Empowered by Generative Artificial Intelligence

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Abstract: *Generative AI boasts real-time generation, dynamic interaction and high operability due to its massive data training and processing capabilities, presenting great application value in education. Currently, junior high school information technology courses face problems such as insufficient student engagement, difficulties in meeting personalized teaching needs, and single and outdated assessment methods. Gamified teaching is student-centered, respects individual differences and supports inclusive instruction. Integrating generative AI into teaching and learning represents a new path for future education. To address practical issues, this paper takes HTML5 and web design as the teaching theme, realizes a natural transition from basic Knowledge to practical application through three game-based subtasks, and designs a four-dimensional evaluation system to comprehensively track students' development.*

Keywords: *Generative Artificial Intelligence, Junior High School Information Technology, Gamified Teaching, Instructional Design*

1. Introduction

The *Compulsory Education Information Technology Curriculum Standards (2022 Edition)* [1] (hereinafter referred to as the *New Curriculum Standards*) has restructured the curriculum content, explicitly stipulating that information technology be separated from the comprehensive practical curriculum and renamed "Information Technology". In 2024, the Ministry of Education issued the *Notice on Strengthening Artificial Intelligence Education in Primary and Secondary Schools*, calling for the coordinated and integrated development of artificial intelligence education in primary, secondary, and tertiary institutions, with the goal of basically popularizing AI education in primary and secondary schools by 2030 [2]. As the main front for implementing artificial intelligence education, information technology classrooms still face many difficulties. In practice, current information technology teaching suffers from low student interest, superficial knowledge comprehension, and weak practical ability [3]. In recent years, the rapid development of generative artificial intelligence has made it a focal point of social attention. Numerous educators have begun to engage in "AI + Education", attempting to use this emerging technology to advance the reform and development of education and teaching. Existing research has confirmed that gamification in teaching has a significant positive effect on improving students' academic achievement [4]. Taking Chongqing University Press edition *Information Technology* — HTML5 website design teaching as a case, this paper, after clarifying practical teaching problems, integrates emerging technologies into gamified teaching for instructional design. On this basis, it aims to promote the development of AI-empowered education, enhance classroom teaching effectiveness, and foster students' core competencies.

2. Problem Identification and Analysis

Through teaching practice, the author finds that insufficient student engagement, difficulties in implementing personalized instruction, simplistic and lagging assessment methods, and superficial knowledge mastery remain the dilemmas in current information technology teaching. Under such circumstances, how to help students acquire knowledge and develop core competencies has become an urgent problem for teachers to solve.

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2.1 Insufficient student engagement

First, some information technology teaching still adopts the traditional form where teachers lecture and demonstrate while students only listen and imitate. This model results in low interactive initiative between teachers and students, and some teachers still face many difficulties in motivating students' learning initiative and enthusiasm [5]. Second, information technology teaching is usually conducted in computer labs, where students—independent individuals with self-awareness—are constantly confined in front of computer screens, greatly reducing their classroom participation. Some students even use information technology classes to watch videos or play games. In addition, some schools attach low importance to information technology teaching, and the weekly class hours are insufficient to meet students' learning needs. To finish teaching tasks quickly, teachers often compress or even cancel team collaboration activities, which further limits teacher-student and student-student interaction.

2.2 Difficulty in meeting personalized teaching needs

In actual teaching, some teachers are still constrained by the traditional teaching model, which follows a "one-size-fits-all" logic. When designing teaching content, teachers adopt a uniform instructional pace that fails to meet the diverse learning needs of students with different cognitive levels and foundational knowledge. This not only hinders the development of students' core competencies and runs counter to the goals of respecting student agency and achieving educational transformation required in the new era, but also leads to academic polarization due to the lack of cognitive stratification based on student characteristics. Specifically, students with weak foundations struggle to keep pace and suffer from knowledge gaps, while high-ability students develop learning inertia because the content is not challenging enough. As a teaching model that respects and accommodates individual differences, personalized instruction is based on students' learning characteristics and interests [6], so as to enhance their internal motivation and promote active learning.

2.3 Single and lagging evaluation methods

In traditional teaching, teachers usually judge students' knowledge mastery based on their final examination scores. This means students cannot receive timely feedback from teachers after completing the final assessment. Once feedback lags, students' learning motivation will gradually weaken. As digital natives, students' all-round development has long been the goal of contemporary education. Academic performance, a typical form of summative assessment, features fixed subjects, content and forms of evaluation. It not only fails to reflect the value of teaching assessment, but also easily leads to students' weariness of learning [7]. Furthermore, such evaluation methods cannot identify blind spots in students' logical thinking. In particular, the programming modules in information technology courses demand students' foundational knowledge and logical transformation; without timely feedback, students cannot monitor their own learning behaviors, thus falling into learning dilemmas such as self-doubt and excessive cognitive load.

2.4 Superficial knowledge mastery

As a discipline that emphasizes both theory and practice, information technology attaches great importance to students' ability to transform theoretical knowledge into practical application. However, two extreme phenomena exist in actual classroom teaching. First, some teachers focus excessively on explaining theoretical knowledge and allocate insufficient time for practical training. Since knowledge in information technology is relatively abstract, rigid and monotonous teaching makes it difficult for students to internalize knowledge into competence, leading to a gradual cognitive disconnect. Second, some teachers overemphasize skill application while ignoring systematic analysis and explanation of knowledge structures. Most practical tasks only require students to repeat what the teacher has demonstrated. This is especially true for programming content, where students unconsciously regard code reproduction as evidence of mastery, yet their knowledge structure remains superficial and cannot be flexibly applied or internalized. Both phenomena share the same problem: the separation of theory and practice. As practice is the sole criterion for testing truth, neither can be neglected. These two tendencies also violate the concept of "learning by doing" and fail to support the coordinated development of students.

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3. Advantages of Generative AI in Empowering Education

Represented by ChatGPT and DeepSeek, generative AI has greatly advanced the intelligent development of education since its emergence, thanks to its powerful feature learning capabilities and unique adaptability [8]. In response to the problems existing in current information technology teaching analyzed above, intelligent tools can be used to help students understand and apply knowledge.

3.1 Innovating Teaching Forms and Boosting Classroom Participation

Traditional classrooms mostly adopt a one-way "teacher lectures, students listen" model, in which students remain passive, leading to disconnection between teachers and students and insufficient student participation. With its outstanding content generation, semantic analysis, and natural language interaction capabilities, generative AI has become a powerful tool to break rigid teaching patterns. Gen AI can act as a classroom assistant to support teaching. After teachers raise questions, it can guide students to think independently and consult AI, enabling them to take the initiative in exploring and solving problems. Furthermore, AI can generate animations, images, video demonstrations and other digital resources to assist instruction, greatly stimulating student interest and promoting integrated communication and interaction among teachers, students, and machines.

3.2 Personalized Teaching and Promoting Educational Equity

Based on Piaget's Cognitive Development Theory, junior high school students are in the formal operational stage (12 years old and above). Students at this stage already possess relatively mature logical thinking, and teachers should provide them with space for independent thinking. Before class, teachers can collect students' preferred learning styles through questionnaires and use AI tools to analyze students' cognitive levels and knowledge foundations, thereby realizing personalized learning situation analysis. The knowledge visualization maps and personalized learning paths provided by generative AI help students preview more knowledge and skills in advance [9]. Teachers can analyze students' cognitive characteristics based on AI feedback and design hierarchical teaching tasks, enabling every student to continuously improve themselves in learning and promote educational equity.

3.3 Timely Feedback and Diversified Evaluation Modes

Educational evaluation should not be reduced to academic performance，it should guide students to broaden their knowledge boundaries and achieve natural knowledge growth. With its powerful capabilities in content generation, dynamic adjustment, and personalized recommendation, generative AI has become a great assistant in teaching. First, multimodal models in generative AI can predict and analyze students’ current learning status and cognitive load, record their classroom behaviors, and track learning progress to form a dynamic learner profile. Second, generative AI can help teachers conduct intelligent analysis and feedback from the dimensions of core competencies, thinking transformation, and psychological state, so as to cultivate well-rounded talents for the new era.

3.4 Situational Design, Emphasizing Both Theory and Practice

In junior high school information technology classrooms, teachers can use generative AI to create situational topics tailored to students’ cognitive levels. These topics can be designed with hierarchical tasks at different difficulty levels, breaking down barriers between theoretical teaching and practical application. This is especially useful in programming instruction, where abstract knowledge and the difficulty of applying theory to practice often lead to student learning fatigue. By combining disciplinary characteristics, teachers can use generative AI to simulate rea-l work scenarios—for example, designing tasks that help designers complete code development and scene generation. This enables students to achieve a cognitive leap from new knowledge t-o practical skills. It avoids the extremes of neglecting practice in favor of theory or focusing only on operation while ignoring systematic knowledge learning, thus realizing classroom teaching that emphasizes applying what is learned and integrating knowledge with practice.

4. Teaching Cases of Generative AI Empowering Junior High School Information Technology

This paper adopts a gamified teaching design for HTML5 Website Development in Unit 4 of the

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Chongqing Edition Information Technology textbook for Grade 7 Volume 1, empowered by generative AI in teaching practice. Gen AI technology is used to address current problems in information technology teaching, including insufficient student engagement, inadequate personalized instruction, simplistic and lagging assessment methods, and superficial knowledge master-y.

4.1 Teaching Objective Design

Based on an analysis of students' cognitive level, the requirements of the new curriculum standards and teaching objectives, combined with course content, teachers will use generative AI to develop appropriate game-based themes. Teachers should strictly review the generated game themes to avoid excessive difficulty in knowledge points. Through human-machine collaboration, relevant knowledge of web design and production will be presented to students, so as to cultivate their core literacy. The specific objectives are shown in the table 1.

Table 1 Teaching Objectives for HTML Website Knowledge.

Core Competencies	Learning Objectives
Computational Thinking	Be able to decompose webpage structures into modular units such as main bodies and individual tags, and develop a procedural thinking pattern of "identifying problems – analyzing logic – solving problems" in the process of troubleshooting webpage issues.
Information Awareness	Be able to clarify the correspondence between HTML code and webpage structure, capture the core information conveyed by webpages in real-life contexts, and recognize HTML code as one of the tools for transmitting digital information.
Digital Learning and Innovation	Through practical tasks, students can proficiently use digital tools for learning. They can design webpage colors, styles and layouts according to their own preferences, gaining rich experience via learning by doing.
Social Responsibility in Information Society	In the process of collaborative webpage creation in groups, students should consciously select positive, healthy, legal and compliant materials, refuse to spread harmful content, and actively maintain a healthy cyberspace.

4.2 Selection of Teaching Strategies

4.2.1 Gamified Teaching

The 2022 Research Report on Games Empowering Education systematically expounds the advantages and characteristics of educational games, emphasizes the significance of research on educational games, and forecasts their future development trends [10]. As an instructional strategy that deeply integrates game elements into teaching, gamified teaching mainly simulates mechanisms such as collaboration, competition, rewards, and feedback in games to stimulate students' internal motivation, reduce cognitive load, and realize teaching through entertainment.

4.2.2 Cooperative Learning

Cooperative learning is characterized by group collaboration as the core, enabling students to carry out division of labor and interactive communication on the premise of clear teaching objectives. Grouping follows the principle of heterogeneous within groups and homogeneous between groups, respecting differences in individual abilities to complement strengths and weaknesses. It transforms individual knowledge learning into collective knowledge construction, allowing students to develop problem-solving and communication skills through discussion and mutual assistance, ultimately achieving deep knowledge internalization and competency development.

4.3 Teaching Practice Design

Centered on the previously formulated teaching objectives and integrating cutting-edge generative AI (Gen AI) technology with the gamified teaching concept, teachers designed a gamified teaching theme titled "Web Designer". This theme constructs three sub-tasks: "HTML Code Rush & Answer Competition", "Broken Webpage Restorer", and "I Am a Web Designer". These sub-tasks follow a natural progression from theory to practice, forming a learning pathway from knowledge modeling to

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competency cultivation.

Scenario Introduction Stage: Teachers first inform students that an animation will be displayed and ask them to focus their attention. After the animation ends, students will complete several tasks. This fully engages students' attention at the start of the class and enhances their participation. The animation is generated using AI technology, focusing on the basic tags in the HTML language. Each tag is presented with a cartoon-like image and introduces itself in the form of a self-introduction, helping students acquire knowledge in line with the interests of junior high school students.

Task 1: "HTML Code Matching Game". This task primarily targets the learning of basic HTML knowledge. After students finish watching the animation, teachers launch the game "HTML Code Rush & Answer Competition" and explain the rules. Specifically, teachers will use Gen AI to generate a rush-and-answer mini-program. Once the program runs, it will display questions that need answering, focusing on the basic HTML tags shown in the animation and their meanings. Students compete to answer: correct answers trigger sound effects, while incorrect answers prompt students with the message, "Don't be discouraged, keep trying!" The number of correct answers is converted into points, which can be redeemed for rewards after the class, thereby boosting students' learning motivation.

Upon completion of the rush-and-answer segment, Gen AI generates a short quiz corresponding to the knowledge points, helping students convert short-term memory into long-term memory. This game activity is designed for all students with basic knowledge difficulty, aiming to help them understand basic concepts and lay a foundation for subsequent activities, enabling a natural transition from basic knowledge to comprehensive application.

Task 2 is "Spot the Differences in Webpage Structure". By this stage, students have already gained a basic understanding of HTML fundamentals. The teacher gradually raises questions such as "What is HTML code used for?" and "Which knowledge we have learned corresponds to the components of a webpage?" If students fail to respond promptly or show unclear understanding of the knowledge structure, the teacher can remind them that the answers lie in Task 1, guiding students to retrieve prior knowledge and reinforce their memory.

Next, the teacher interacts with AI and instructs it to generate a basic static webpage. The source code of this webpage is then sent to student devices via the classroom control terminal, allowing students to run the code independently. When errors occur during execution, students may either consult the teacher or communicate with AI to resolve the issues.

Once the static webpage runs properly, the teacher divides students into groups based on their ability levels. AI acts as a questioner and poses random questions to each group. Students take on the roles of "source code readers" and "webpage interface observers" by viewing the source code through the browser shortcut "**Ctrl+U**." The AI then asks questions such as "Which tag defines the webpage title?" Group members open the source code to answer. The more correct responses given within the time limit, the higher the points earned.

In the form of AI-facilitated Q&A, this task helps students grasp the connection between theoretical knowledge and practical application, fully embodying the concept of "learning by doing".

Task 3 is "I Am a Web Designer". This task includes two difficulty levels: the basic level only requires static webpage design, while the advanced level centers on dynamic webpage development. Students can choose freely according to their own conditions.

First, the teacher announces that an inter-group class competition will be held at the end of the course, where students' final works will be evaluated for points that can be redeemed for blind boxes. Notably, different point values are assigned to basic and advanced tasks. The theme of Task 3 is to create a webpage promoting their hometown in groups. The teacher allocates two class periods for completion; groups that finish ahead of time will receive bonus points.

Throughout the webpage development process, group members cooperate by dividing responsibilities: students may use AI tools such as Doubao and DeepSeek to collect traditional culture and multimedia materials about their hometowns; students with stronger programming skills build the basic webpage framework; and those with better aesthetic abilities handle webpage UI design, color matching, and other tasks. After finishing the initial webpage, students can also consult AI for suggestions on optimization.

Based on practical project-based learning, this task builds a bridge from theoretical instruction to real-world application, further improving students' knowledge transfer ability.

Through these three tasks, the learning of HTML webpage design knowledge is integrated into

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gameplay, supported by generative AI to realize teacher-student-machine collaboration. The three tasks sequentially enable students to acquire new knowledge, understand concepts in depth, and apply skills in practice.

4.4 Teaching Evaluation Design

To fully understand students' development in cognitive level, participation, collaboration ability and other dimensions throughout the teaching process, this paper conducts evaluation from four aspects: learning engagement, effectiveness of tool application, knowledge mastery, and group projects, so as to construct a learning portfolio for each student.

First, learning engagement. This dimension consists of two evaluation modes. One is teacher-led group assessment: teachers participate in the whole teaching process and score students based on their active involvement in game tasks, teacher-student interaction and peer interaction. Students who actively participate and communicate in games are regarded as having high classroom engagement.

The other is to retain teaching videos with the consent of students, parents and the school, use AI technology to analyze student behaviors, generate engagement reports, and present relevant data visually. This evaluation emphasizes students' dominant role in learning, focuses on their learning experience, and injects vitality into the classroom.

Second, effectiveness of tool application. This evaluation mainly examines whether students can flexibly use emerging technologies to solve problems in study and daily life. Specifically, it includes whether students can construct appropriate prompts to communicate with AI, con-duct multiple iterations of code generation scenarios, and treat AI-generated content with critic-al thinking.

Teachers should remind students that although AI brings much convenience, they must also be alert to potential risks, recognizing that AI is only an auxiliary tool rather than a replacement for independent thinking and learning.

Third, knowledge mastery. This dimension mainly assesses students' command of webpage design knowledge. Teachers can use AI to generate test questions covering basic knowledge identification — such as the functions and attributes of basic HTML tags — as well as practice-al application of knowledge, to evaluate how well students understand and master the content. This evaluation helps students monitor their own learning and provides timely feedback on their learning status.

Fourth, group projects. This evaluation focuses on the completion of group works to comprehensively understand students' overall development. It includes but is not limited to: whether group members take the initiative to fulfill their duties in division of labor, whether they actively participate in group communication, students' project iteration records, whether the design is reasonable, and whether color matching reflects aesthetic literacy.

Teachers create an environment for peer evaluation among groups, allowing students to put forward appropriate optimization suggestions. This helps judge whether students' comprehensive literacy has been effectively improved and promotes the transformation from individual learning to collective knowledge construction.

5. Conclusion

Through the four-dimensional evaluation system described above, learning is promoted through gamified teaching and empowered by cutting-edge technologies. Multi-dimensional assessment enables an accurate grasp of students' learning status, literacy and abilities, forming a replicable teaching path for technology-empowered education. However, the integration of AI with other knowledge in information technology and the application of gamification still require continuous exploration in future practice, moving from implementation to driving educational reform.

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