Research on the Construction of a New "Smart Adaptive－Project-Based" Teaching Model for the EXCEL and Data Statistical Analysis Course Empowered by AIGC

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Abstract: *The rise of generative artificial intelligence (AIGC) technology has provided revolutionary tools for the digital transformation of higher education and the innovation of teaching models. In response to the core problems commonly found in the current teaching of the EXCEL and Data Statistical Analysis course — namely, the "separation of knowledge and practice," "teaching homogenization," and "weakening of thinking cultivation"—this study aims to construct a new teaching model oriented toward cultivating students' higher-order thinking and their ability to solve complex problems. This study proposes a "Smart Adaptive－Project-Based" teaching theoretical framework that integrates the trinity of "AIGC －PBL －Platform," and systematically elaborates on the in-depth integration logic whereby AIGC serves as a "cognitive partner," project-based learning (PBL) functions as a "practical context," and the online teaching platform acts as a "collaborative foundation." Theoretically, this study demonstrates the potential value of this model in promoting personalized learning, deepening knowledge construction, and fostering data thinking and intelligent literacy. It also provides a forward-looking discussion of the key conditions for successful implementation, potential challenges, and corresponding coping strategies, with the aim of offering a complete and operable design blueprint and theoretical reference for systematic teaching reform in similar courses under the context of intelligent technology.*

Keywords: *Generative artificial intelligence (AIGC); Project-based learning (PBL); EXCEL teaching; Construction of teaching model; Data literacy; Smart adaptive learning*

1. Introduction: The Inevitable Turn of Curriculum Teaching Reform in the Digital Intelligence Era

Against the macro background of the digital economy becoming a national core competitiveness, data literacy has been elevated from a professional skill to a necessary general literacy for all types of professionals. The course EXCEL and Data Statistical Analysis, as a foundational tool course for cultivating students' abilities in data acquisition, processing, analysis, and presentation, nevertheless exhibits prominent contradictions in its current teaching status: there is a huge gap between the "lofty" course objectives (cultivating data thinking and decision-making ability) and the "flat" teaching practice (reduced to software functional operation training). This is specifically manifested as a triple dilemma: First, the dilemma of "separation of knowledge and practice," where students' knowledge transfer ability is weak; second, the dilemma of "teaching homogenization," where personalized guidance is seriously lacking; and third, the dilemma of "superficial thinking cultivation," where there is a lack of deep thinking training.

Meanwhile, generative artificial intelligence (AIGC) technologies, represented by ChatGPT and ERNIE Bot, possess the potential to act as "personalized tutors" and "knowledge collaborators." Project-based learning (PBL) is also regarded as an effective framework for promoting deep learning; however, it often faces bottlenecks such as limited instructional guidance and complex process management when implemented on a large scale.

Therefore, the fundamental proposition of this study is: How can the "intelligence" of AIGC, the "project" of PBL, and the "process" of the digital teaching platform be systematically integrated to design a new teaching model that can both be implemented at scale and support personalized in-depth

inquiry? This study aims to conduct forward-looking theoretical construction and pathway design, propose the new "Smart Adaptive – Project-Based" teaching model, and provide a clear theoretical navigation and action blueprint for subsequent teaching empirical research and curriculum paradigm transformation.

2. Literature Review and Research Entry Point

Currently, the integration of information technology with education and teaching has entered a deep-water zone. The application of online teaching platforms (such as Superstar Learning Platform and China University MOOC) has become widespread, and related research mainly focuses on resource construction, blended teaching management, and the like. However, there is a general problem of "shallow application of platforms," meaning that platforms are mostly used as tools for content distribution and assignment management, failing to fully tap their potential for data interaction and intelligent hub functions. In terms of PBL research, a large body of literature confirms its value in enhancing learning initiative and practical ability, yet "difficulty in PBL implementation" is a widely recognized challenge. Especially in large classes of over a hundred students, instructors face enormous guidance pressure, and the project process tends to become formalistic or out of control. Regarding the application of AIGC in education, current research exhibits a "polarization": on the one hand, it focuses on macro-level theories and ethical discussions; on the other hand, it centers on tool-based applications for single tasks such as lesson preparation and test question generation. There is a lack of meso-level research that deeply integrates AIGC as a core element into the complete teaching process of a course and systematically combines it with PBL and online platforms.

To sum up, the existing research suffers from a fragmentation among "platform," "method," and "technology," failing to form a synergistic force. This very gap constitutes the core entry point of this study. This project aims to directly address the above research lacuna and attempt a systematic teaching reconstruction: using the Superstar Learning Platform as the execution carrier to ensure process standardization and data aggregation; employing carefully designed PBL as the teaching framework to provide authentic and challenging learning contexts; and utilizing a course-customized AIGC agent as the core empowering tool to offer personalized and intelligent cognitive support throughout the entire PBL process. By constructing this "trinity" integration model, this study expects to simultaneously resolve the difficulties of "shallow platform application," "difficult PBL implementation," and "fragmented AIGC application," and to explore an innovative and generalizable pathway for teaching reform.

3. Theoretical Framework: Systematic Construction of the Trinity Integration Model of "AIGC – PBL – Platform"

3.1 Core Concept

This model pursues a dual fundamental transformation in teaching paradigms. The first transformation concerns the course objective, that is, shifting from cultivating "proficient software operators" to fostering "competent data interpreters and strategic advisors." The second transformation concerns the teaching process, that is, shifting from "teacher-centered linear instruction" to "student- and project-progress-centered ecological smart adaptive learning." In this ecology, the teacher acts as the designer and coach of the learning environment, while the student acts as an active problem solver and collaborative worker with intelligent tools.

3.2 Framework Analysis of the "Trinity" Integration Model

The effectiveness of the "Smart Adaptive – Project-Based" teaching model constructed in this study is rooted in the deep coupling and synergistic enhancement among AIGC, PBL, and the online teaching platform. These three elements form a stable "triangular structure," each indispensable, jointly supporting a new teaching ecology.

AIGC: As a Deeply Empowering Cognitive Partner and Intelligent Scaffold. In this model, AIGC is positioned as a "domain-specific intelligent agent" embedded with disciplinary knowledge. It transcends general-purpose chatbots by being specialized through the injection of a course knowledge graph (core concepts, typical cases, common error patterns, and project methodologies). Its core

functions include:

a. Immediate and precise cognitive support: providing 24/7 concept explanations, operational guidance, error debugging, and code generation to address the issue of delayed feedback;

b. Thinking scaffolds throughout the process: serving as a "brainstorming partner," "analytical strategy advisor," and "report polishing assistant" at each stage of PBL, inspiring students' thinking through high-quality dialogue rather than directly providing answers, with the aim of "teaching one to fish";

c. Data-driven insights into learning conditions: by analyzing interaction logs, preliminarily identifying students' knowledge weaknesses, interest directions, and thinking bottlenecks, and providing a basis for teachers' precise interventions. The value of AIGC lies in liberating both teachers and students from a large number of repetitive, fact-based question-and-answer exchanges, thereby allowing teaching interactions to focus on higher-level activities such as evaluation, creation, and emotional engagement, thus realizing a redistribution of cognitive labor.

PBL: As a Contextual Carrier and Driving Framework for Reconstructing Learning Experience. PBL serves as the "skeleton" that integrates knowledge and skills within this model. We advocate designing a series of authentic, challenging, and open-ended "macro-tasks" as projects, such as "Consumer Behavior Insights and Marketing Strategy Simulation Based on Public E-Commerce Data" and "Campus Carbon Emission Data Estimation and Emission Reduction Scheme Research." These projects possess the following characteristics:

a. Anchored in reality: the problem contexts and data sources are highly simulated or directly derived from the real world, endowing learning with intrinsic meaning and driving force;

b. Integrated knowledge: they naturally cover the entire knowledge chain from data acquisition, cleaning, organization, descriptive statistics, multi-dimensional analysis to visual presentation, breaking down the barriers between chapters;

c. Encouraging inquiry: there is no preset single correct answer; multiple pathways of exploration, solution iteration, and critical discussion are encouraged, and failure is embraced as part of learning. PBL transforms discrete knowledge points into a "toolbox" needed for solving complex problems, enabling students to achieve deep knowledge construction and organic competence growth through "learning by applying," thereby effectively addressing the problem of "separation of knowledge and practice."

Online Teaching Platform: As an Integrated Digital Foundation and Process Engine. Modern teaching platforms, represented by Superstar Learning Platform, play the key role of an "operating system" in this model. Their functional integration is manifested in:

a. Process management hub: releasing project tasks, organizing group collaboration, managing document versions, and planning time nodes, ensuring the orderly and transparent progression of the complex PBL process;

b. Resource aggregation portal: centrally storing all digital resources such as course handouts, micro-videos, datasets, AIGC usage guides, and excellent case libraries, forming a "knowledge supermarket" that can be accessed at any time;

c. Data aggregation and perception center: seamlessly integrating AIGC interaction data, student learning behavior data (logins, browsing, interactions), and project process data, to form a panoramic digital learning profile, providing data perception capabilities for "smart adaptation," and shifting teaching decisions from experience-driven to data-driven;

d. Multi-dimensional assessment support platform: supporting peer evaluation, process-based portfolio assessment, and comprehensive evaluation that combines quantitative data with qualitative evidence, thereby promoting reform in assessment methods. The platform serves as a bridge connecting AIGC and PBL, enabling intelligent empowerment to be applied to the entire project process in a standardized and traceable manner.

3.3 Detailed Description of the "Four Stages and Six Links" Project Implementation Process and AIGC Empowerment Points

Based on the above framework, we have designed a closed-loop implementation process of "Four Stages and Six Links," and have clearly specified in detail the key empowerment points of AIGC and

the core activities of teachers and students at each stage. This design aims to provide a highly operable teaching "script."

3.3.1 Stage 1: Launch and Definition

Link 1-Context Immersion and Problem Anchoring: The teacher releases an engaging project statement and a real dataset. Student groups discuss and preliminarily understand the business context. AIGC empowerment: Students can instruct AIGC to quickly generate a summary of background knowledge in the project domain or explain core business terminology, thereby accelerating contextual understanding.

Link 2-Analysis Planning and Scheme Design: The group defines the core problem, decomposes it into several specific analysable sub-problems, and formulates a preliminary technical roadmap. AIGC empowerment: Students can input vague ideas into AIGC and ask it to help organize the analytical logic, generating a draft project plan that includes "analysis dimensions," "required data fields," and "Excel functions that may be used." AIGC can also act as a "devil's advocate," questioning the feasibility of the plan and prompting more thorough thinking.

3.3.2 Stage 2: Execution and Inquiry

Link 3-Data Acquisition and Governance: Students obtain the data and face real challenges such as missing values, outliers, and inconsistent formats. AIGC empowerment: Students send data snippets or descriptions to AIGC and ask, "What quality issues exist in the data?" and request corresponding data cleaning formulas (e.g., using TRIM, CLEAN, IFERROR, and VLOOKUP for standardization). AIGC needs to explain the logic behind the formulas so that students understand the cleaning principles rather than merely copying the code.

Link 4-Multi-dimensional Analysis and Visual Exploration: This is the core challenging link. Students attempt to mine insights from the data from different perspectives. AIGC empowerment: Students describe their analytical intent in natural language, for example, "I want to compare sales across different regions and product categories, and highlight the best- and worst-performing combinations." AIGC can recommend using "nested classification pivot tables" combined with "conditional formatting" or "3-D clustered column charts," and provide step-by-step operation guides. For more complex statistical needs (such as correlation and regression), AIGC can explain their applicable conditions and the basic methods for implementing them in Excel.

3.3.3 Stage 3: Integration and Creation

Link 5-Insight Extraction and Report Synthesis: Students integrate their analytical findings and produce a logically rigorous, evidence-based, and professionally presented analysis report. AIGC empowerment: As a "collaborative author," AIGC can:

a. Suggest a narrative logic for the report (e.g., "overview-details-overview" or "problem-solution") based on the scattered conclusions provided by the students;

b. Polish descriptive text to make it more professional and concise;

c. Generate multiple expression versions for key data conclusions (such as conservative, aggressive, and innovative recommendations) for students to compare, select, and integrate — a process that is highly valuable for developing their thinking skills.

3.3.4 Stage 4: Evaluation and Reflection

Link 6-Achievement Presentation and Metacognitive Reflection: Each group presents their work in a public defense session and responds to questions from both the teacher and fellow students. Each individual is required to submit an in-depth reflection journal. AIGC empowerment: Before the defense, students can ask AIGC to simulate a panel of judges, posing sharp questions from the perspectives of data reliability, methodological rigor, and practical applicability of the conclusions, thereby conducting a "stress test." During the reflection phase, the teacher can design structured questions to guide students in reviewing their key dialogues with AIGC, prompting them to think about: "What was my most successful question, and why?" and "Which response from AI misled or inspired me, and how did I make that judgment?" This process significantly enhances their metacognitive abilities and critical thinking.

4. Potential Outcomes, Key Challenges, and Systematic Promotion Strategies for Model Implementation

4.1 Anticipated Outcomes and Multi-Dimensional Value

Theoretical reasoning and practical experience suggest that this model is expected to yield significant outcomes in the following four dimensions:

Learning Outcome Dimension: It is anticipated that the model will substantially enhance students' comprehensive ability to apply data in complex scenarios, their visual storytelling skills, and their report writing capabilities. Project outputs will be more closely aligned with real-world industry needs, and students' confidence and competence in solving authentic problems will be strengthened.

Learning Experience Dimension: With the immediate and personalized support provided by AIGC, students' sense of frustration is expected to decrease, while their courage to explore and autonomy will increase. Satisfaction surveys are likely to show positive feedback on indicators such as "perceived personalized support" and "learning engagement."

Teaching Efficiency Dimension: The AI teaching assistant will undertake a large number of repetitive Q&A tasks, freeing teachers from heavy elementary guidance and allowing them to devote more energy to instructional design, higher-order thinking guidance, and targeted intervention for individual difficulties, thereby elevating the value of teachers' labor.

Competency Cultivation Dimension: What students implicitly learn in this process are the core competencies essential for coexisting with the intelligent era, including "human-AI collaboration ability" (effectively utilizing AI), "critical thinking" (scrutinizing AI outputs), and "problem-modeling ability" (clearly articulating problems to AI). These transcend traditional course objectives and empower students' long-term development.

4.2 Key Challenges and Coping Strategies

The implementation of this model must anticipate and address the following challenges:

The new form of "digital divide": Students' ability to craft prompts for AIGC and their capacity to discern information will diverge. The coping strategy is to include "effective dialogue with AI" and "critical evaluation of AI outputs" as compulsory course content, and to systematically train these skills by providing templates, case-based teaching, and incorporating effective questioning into process-oriented assessment.

Academic integrity and assessment reconstruction: There is a risk of AI-generated work being passed off as students' own. The strategy is to thoroughly reform the assessment system by establishing a process-oriented and traceable mechanism, substantially increasing the weight of process-based evidence such as project plans, data logs, key AI dialogue records, report iterations, and defense source tracing, so that the focus of evaluation shifts from "correctness of results" to "soundness of process and depth of thinking."

Anxiety over teacher role transformation: Teachers need to shift from "lecturer" to "facilitator," which brings pressure to upgrade their competencies. Institutions should build a support system by offering workshops, establishing teaching and research communities, and setting up incentive funds, thereby systematically supporting teachers' development in course design, technology integration, and process guidance capabilities.

Balancing technology dependence and the essence of education: It is necessary to prevent technology from weakening deep interpersonal interaction. The role of technology must be clearly defined as "auxiliary." Teaching activities that must be human-led, such as project value discussions, ethical debates, and emotional feedback, should be carefully designed to ensure that technology serves the fundamental purpose of education.

5. Conclusion and Outlook

This study has constructed the "Smart Adaptive – Project-Based" teaching model with the trinity integration of "AIGC – PBL – Platform," which represents a systematic response to the pain points in current course teaching. It transcends mere improvement of a single technology or method, aiming

instead to reshape the goals, processes, and ecology of learning through the reorganization of key elements, thereby fundamentally resolving the persistent problems of "separation of knowledge and practice," "teaching homogenization," and "superficial thinking cultivation." It provides frontline teachers with a complete action blueprint from conception to implementation.

Admittedly, the effectiveness of this model remains to be tested and refined through empirical teaching research. Future studies may be deepened along three directions: First, conducting teaching experiments, collecting multi-source data, and carrying out both quantitative and qualitative evaluations and iterations of the effects; second, developing shareable course resource packages (such as a PBL project library and an AIGC knowledge base guide) to lower the threshold for application; and third, exploring the integration with learning analytics to upgrade AIGC support from "responsive" to "predictive," thereby achieving genuine smart adaptation.

We firmly believe that teaching innovation centered on students, leveraged by technology, and driven by systemic design is the key to promoting the connotative development of higher education. It is our hope that this study will inspire further explorations, and together transform such courses from "skill training" into "thinking training grounds" and "innovation incubators," contributing to the cultivation of outstanding talents for the digital era.

Fund Projects

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