Chapter 12
Innovating Classrooms Through Project-Based Learning: Success Stories from China

Yifan Zhang, Danwei Chen, Ting Da, and Xinyi Cao

12.1 Introduction

Project-Based Learning (PBL) prepares students for a rapidly changing world by emphasizing inquiry, collaboration, and real-world problem-solving. PBL goes beyond textbooks and exams, encouraging students to explore meaningful questions, design creative solutions, and connect school experiences to real life (Shi & Li, 2024). In China, where educational reforms focus on innovation, interdisciplinarity, and student well-being, PBL is gaining traction in schools.

This chapter presents successful PBL examples from China, showing how educators are reshaping learning to foster deeper engagement, critical thinking, and practical skills. These are real, tested models of student-centered learning in practice.

The chapter is organized around four key themes. First, Learner Agency and Voice highlights how PBL empowers students to take ownership of their learning. With support, even young learners can ask questions, make decisions, and reflect on their growth.

Y. Zhang (✉) · D. Chen · T. Da
Beijing Normal University, Beijing, China
e-mail: zhangyifan@bnu.edu.cn

D. Chen
e-mail: estellechen55@163.com

T. Da
e-mail: tingda@bnu.edu.cn

X. Cao
Central China Normal University, Wuhan, Hubei Province, China
e-mail: caoxinyi@ccnu.edu.cn

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Next, Creativity Across Disciplines shows how interdisciplinary projects stimulate imagination and innovation. By integrating music, literature, design, and engineering, students build creative confidence while applying knowledge in meaningful ways.

The third section, Technology as a Learning Scaffold, demonstrates how digital tools and platforms enhance PBL, personalizing learning, fostering collaboration, and expanding teaching and assessment possibilities.

Finally, Designing for Real-World Impact illustrates how PBL enables students to tackle real-world problems, going beyond academics to promote health, civic engagement, and entrepreneurial thinking.

These four themes provide a comprehensive view of how PBL is applied in China, offering valuable insights for educators and policymakers striving to make learning more relevant, inclusive, and future-ready.

12.2 Case Study

12.2.1 Learner Agency and Student Voice

At the heart of project-based learning (PBL) lies a fundamental shift from viewing students as passive recipients of knowledge to recognizing them as active participants, decision-makers, and creators. Well-designed PBL experiences foster learner agency and amplify student voice across diverse age groups and disciplines. For instance, Dobson and Dobson (2021) found that engaging students as teachers in PBL-based character education significantly enhanced their engagement, self-expression, and sense of empowerment. From the curiosity-driven exploratory play of kindergarteners to personalized learning paths shaped by cognitive development, and from creative expression in writing and art to interdisciplinary projects, these six cases illustrate how students take ownership of their learning and make their thinking visible. Whether through literary interpretation, cultural artifact creation, or reflective self-assessment, PBL enables students not only to acquire knowledge, but also to articulate their identities, values, and perspectives (Chen et al., 2023).

12.2.1.1 Fostering Active Learning in Early Childhood Through Project-Based Learning: A Case Study of the "Hello, Little Fish" Project in a Kindergarten Middle Class

This article examines how project-based learning (PBL) promotes active learning in preschool children, using the "Hello, Little Fish" project as a case study. Based on national education policy and early childhood development theory, the research highlights issues in traditional preschool instruction, where children's interests are often overlooked, and learning is passive.

The project began with a spontaneous conversation about fish, which the teacher used to spark an inquiry-driven learning experience. Throughout the project, children explored real-life questions such as fish care, aquatic plant oxygen production, and the concept of death. Three key strategies emerged: posing meaningful questions, supporting children's expression through debate and hands-on learning, and respecting their choices to encourage reflection and self-constructed knowledge.

The study shows that when PBL is rooted in children's interests and guided by responsive teaching, it empowers young learners to take ownership of their learning, express their ideas, and co-construct knowledge. It fosters deeper cognitive engagement, empathy, and holistic development. The article advocates for the broader adoption of PBL in early childhood education as a powerful way to realize child-centered learning through learner agency and voice.

12.2.1.2 From Passive to Active: Promoting Student Autonomy Through the "D + 33" Model in an Interdisciplinary Project-Based Learning Activity at Baicaoyuan

"The 'D+33' smart classroom model at Shenzhen's Shuitian Elementary School promotes learner agency by integrating data-driven personalization with student-centered learning cycles such as guided thinking, collaborative inquiry, and reflection. Such an approach resonates with adaptive pedagogical frameworks advocated in the literature. For instance, Peng et al. (2019) describe personalized adaptive learning in smart environments as a key educational innovation that empowers students to take ownership of their learning. Similarly, Wu et al. (2024) emphasize the role of student modeling and personalized recommendations in building intelligence-driven learning systems."

Using digital tools like AIGC, VR/AR, and online platforms, students explored traditional Chinese medicine (TCM), engaging in activities such as planting, designing herb catalogs, creating herbal tea recipes, and making TCM-themed digital videos. These projects were driven by student interests and creativity, showcasing how technology can amplify student voice.

Students also took on real-world roles, such as museum docents, deepening their ownership and practical application of knowledge. The system's diverse evaluation—AI assessments, peer feedback, and digital portfolios—provided multiple opportunities for students to express understanding and reflect on progress. Overall, this initiative highlights how smart education fosters learner agency, transforming students into autonomous, expressive, and culturally engaged learners.

12.2.1.3 Integrating Cognitive Development–Based Personalization into Project-Based Learning: A Practice-Oriented Study

This study examines how cognition-based personalized learning, integrated into project-based learning (PBL), enhances learner agency and voice among fourth-grade students in Shanghai. Traditional PBL often struggles with academic impact, so this research explores a model that aligns projects with individual cognitive profiles to boost student ownership.

The intervention focused on a mathematics unit on "Introductory Concepts of Circles," where students' cognitive readiness was assessed initially. Learning materials, tasks, and pacing were personalized accordingly. Students were empowered to create their own inquiry questions, choose from differentiated resources (e.g., video tutorials, peer collaboration), and reflect through iterative revisions, promoting choice and self-direction.

Students were also encouraged to articulate their reasoning, share strategies with peers, and co-design solutions, transforming the classroom into a collaborative space. Teachers facilitated learning, intervening at key moments identified through real-time analytics.

12.2.1.4 Bringing Writing to Life: Constructing a Precision Assessment Model in Junior Secondary Chinese Through Project-Based Learning

This study proposes a precision-oriented evaluation model for project-based learning (PBL) in junior high school Chinese, aimed at aligning teaching goals, learning activities, and assessment practices. Based on the theory of "teaching–learning-assessment consistency," the model seeks to enhance students' core literacy while ensuring coherent and adaptive evaluation throughout the learning process.

The framework, called "One Guide • Two Changes • Three Dimensions • Four Links • Five Angles," shifts focus from summative to formative, diagnostic, and responsive evaluations, providing detailed insights into both academic performance and personal growth. It introduces horizontal, vertical, and internal consistency, and structures assessment into four stages: goal alignment, criteria calibration, process tracking, and multi-source feedback.

Students are active evaluators through self- and peer assessments, supported by teacher, parent, and societal input. In the "Ordinary Light" PBL unit, smart pens and rubric-based scales provided real-time data for individualized feedback, fostering continuous improvement.

12.2.1.5 A Project-Based Learning Case on Classic Literature: "Alice's Adventures in Wonderland"

This paper introduces a junior high school PBL project focused on *Alice's Adventures in Wonderland*, aimed at enhancing learner agency and voice through a student-centered approach to classic literature. Developed at Qingyun No.5 Middle School, the project unfolds in three phases: reflective reading, creative adaptation, and thematic inquiry.

In the first phase, students read independently, journal, and create mind maps reflecting their personal interpretations of the plot and characters, fostering ownership and analytical skills.

The second phase encourages students to reimagine and perform scenes from the novel. They collaborate to write scripts, design props, and act, balancing text fidelity with creative freedom. This expressive performance deepens their emotional connection to the literature.

In the final phase, students create group micro-lectures on topics of their choice, developing research and presentation skills. They have full control over what they explore, how they argue, and how they present their ideas.

12.2.1.6 Technology-Enhanced Transformation of Learning Approaches: A Project-Based Learning Case on Paper-Crafted Bronze Chime Bells

This article presents a case study from Guocikou Elementary School in Wuhan, where students participated in a project-based learning initiative to recreate bronze chime bells using paper engineering and digital tools. Inspired by the Zenghouyi bells, the project emphasized learner agency and voice through a five-phase design, from cultural research to exhibition.

Students actively designed, programmed, and presented their bells, making decisions like selecting vibration sensors and programming melodies. They used tools such as 3D modeling software, VR, and Mind+ to connect ancient craftsmanship with modern maker education.

Students shaped both the learning process and the products, documenting their work in digital portfolios, engaging in peer and self-assessment, and acting as cultural docents during exhibitions—showing their voice in academic and community contexts.

The project encouraged meaningful choices, personal expression, and interdisciplinary exploration across art, music, technology, and language. Through assessments and merit-based recognition, students were empowered to reflect on and share their learning experiences.

Overall, the study demonstrates how culturally grounded PBL fosters student autonomy, identity, and expressive competence, exemplifying learner agency and voice.

12.2.2 Creativity Across Disciplines

12.2.2.1 A Symphony of Smart Learning: Educational Practice of "Creating the Sound of the Future—The Music Performer"

The "Creating Sound Futures: Music Performer" program by Jiaging Youth Activity Center blends music and STEM through STEAM, fostering creativity and technical skills. Students gain programming and composition abilities, with 90% reaching intermediate coding proficiency and 85% completing electronic music pieces. Feedback shows a 40% rise in interest in music-tech integration and improved teamwork.

Key strengths include merging music with engineering, personalized learning, and real-world exhibitions. Areas for improvement include balancing theory with practice and enhancing technical support. Planned upgrades involve micro-lectures and peer mentoring. This model highlights how arts can teach tech skills, offering a replicable approach for interdisciplinary education.

12.2.2.2 Task-Driven, Smart-Enabled: Precision-Guided Project-Based Writing on Imaginative Narratives—A Case Study of "the Amazing Adventure" in Grade 5 Chinese Textbook

This study examines a task-driven approach to teaching imaginative writing in elementary schools, using the fifth-grade composition "A Magical Adventure" as an example. Traditional methods often neglect creativity, so the study integrates project-based learning (PBL) and digital tools to boost engagement and writing skills. The method emphasizes real-world scenarios, collaboration, and interactive assessments.

The model follows four phases: setting objectives, using tech for research, scaffolding techniques, and multi-dimensional evaluations. Students select themes, share resources digitally, and refine narratives with teacher guidance. Tools like smart pens and peer feedback support iterative revisions.

Results show improved storytelling, with creative outputs like audio recordings and illustrated diaries. The approach aligns with China's 2022 curriculum standards, proving PBL and digital tools enhance creativity, critical thinking, and collaboration. This framework offers a replicable model for modernizing writing instruction.

12.2.2.3 Design and Application of PSR-Based Interdisciplinary Project Learning in Elementary School English with IT Support: A Case Study of "Make a Travel Handbook"

This study examines a cross-disciplinary PBL activity in elementary English using the PSR model (Problem–Solution-Result) and IT support. The *"Make a Travel Handbook"* project integrates English with geography, art, and IT, improving language skills, critical thinking, and collaboration.

Students select destinations and tackle real-world sub-problems (transport, weather, culture) using AI writing tools, data analysis software, and design techniques. They create bilingual handbooks and presentations, blending technical and creative tasks.

Evaluation assesses language, teamwork, and problem-solving through peer/teacher feedback. While successful, challenges include AI over-reliance and uneven participation. The study highlights PSR-based PBL's potential to foster 21st-century skills, offering a replicable model for student-driven, tech-enhanced learning.

12.2.2.4 Interdisciplinary Thematic Teaching Based on Problem-Solving and Collaboration Supported by Information Technology

This paper introduces an interdisciplinary teaching model from Shenzhen's Longhua District Education Science Research Institute Affiliated School, combining problem-based learning, collaboration, and digital platforms. Aligned with Education 4.0 and China's competency-focused reforms, the model uses technology to create a dynamic learning ecosystem. Teachers and students co-design projects, supported by expert training, a smart education platform, and a dual-path system blending thematic activities with coursework.

Results show 65% of teachers now lead interdisciplinary classes, with student projects surging from 12 to 108 annually (96% teacher participation). Technology handles routine tasks, freeing educators for creative teaching, while students engage in robotics, gardening, and other hands-on projects to boost critical thinking.

The model transforms classrooms into collaborative hubs, linking subjects like robotics and ecology to foster 21st-century skills. Its success offers a replicable blueprint or innovative, cross-disciplinary education.

12.2.2.5 A Math + X Interdisciplinary Project-Based Teaching Case in Smart Education: Designing an Arch Bridge

This case study examines a specialized IT curriculum at Beijing Normal University High School, blending compulsory and elective modules through project-based learning (PBL). Thematic units like "Data and Big Data" and "Information Systems

and Social Responsibility" form the core, while electives such as AI, Open-Source Hardware, and 3D Design enable advanced exploration.

Results show boosted student motivation, problem-solving skills, and tangible projects like AI path planning. Teachers also gained pedagogical insights. However, challenges include rigid scheduling (three consecutive IT classes caused fatigue/absenteeism) and limited competition participation due to semester constraints.

The program aims to enhance interdisciplinary links (e.g., AI + ethics, 3D design + environmental science), fostering real-world problem-solving. It balances national standards with innovation, offering a model for creative IT education.

12.2.2.6 "Bridge Engineer": a Model Case of Project-Based Learning

Qiaotou Elementary School's Bridge Engineer project combines 3D printing, programming, and smart systems in a hands-on PBL initiative that develops creativity and problem-solving skills. Students design futuristic bridges with intelligent features like traffic monitoring, merging engineering, art and technology through four key phases: researching and designing blueprints, 3D printing models, programming smart functions like LED traffic alerts, and system integration. The collaborative process emphasizes peer feedback and teacher facilitation while assessing computational thinking, creativity, and teamwork. Though successful in boosting engagement, challenges include balancing guidance with independence and improving evaluation methods. This initiative demonstrates PBL's power to connect theory with practice, fostering 21st-century skills while inspiring future cross-disciplinary maker education that breaks traditional subject boundaries.

12.2.3 Technology as a Learning Scaffold

In the digital age, technology is no longer just a tool for delivery, it has become an active scaffold that shapes how students engage with knowledge, collaborate, and solve real-world problems. When thoughtfully integrated into project-based learning (PBL), smart platforms, artificial intelligence, and data-driven tools can deepen inquiry, personalize learning pathways, and provide timely feedback that empowers both students and teachers. Research shows that such technology-enhanced PBL approaches improve student engagement and foster critical 21st-century skills across disciplines (Chen et al., 2020). This section features seven cases from diverse Chinese classrooms that exemplify how technology-supported PBL transforms subject instruction across science, mathematics, and language learning. From digital ecosystems that seamlessly link teaching, learning, and assessment, to intelligent platforms that amplify cultural inquiry and creative expression, these cases illustrate how digital innovation serves as a backbone for scalable, meaningful, and future-ready education (Zhu & Liu, 2021).

12.2.3.1 Enhancing Project-Based Learning Through Smart Platforms: Integrating Teaching, Learning, and Assessment

This study examines how smart platforms scaffold the teaching–learning-assessment (TLA) process in project-based learning (PBL) at Changzhou Zhengheng Middle School through an English project titled Being A Good Student. By integrating AI and natural language processing, the platform captures multimodal classroom data, including audio, video, and interaction patterns, and transforms it into visualized, actionable feedback that guides both teachers and students.

The platform scaffolds learning by aligning project outcomes with China's student development framework, assessing knowledge, critical thinking, and social engagement using customized rubrics. Collaboration analytics provide insights into interaction quality, helping teachers foster equitable student participation and shift toward student-centered inquiry. Dynamic assessment delivers instant feedback on project deliverables, enabling students to iteratively refine their work and build competence gradually.

By triangulating quantitative data (e.g., participation rates, thematic relevance) with qualitative reflections (teacher journals, peer reviews), the system supports evidence-based adjustments in pedagogy and curriculum design. This data-driven scaffolding helps learners progress within their zone of proximal development, promoting autonomy while maintaining structured support.

While challenges remain in interpreting implicit cultural behaviors behind the data, this approach illustrates how technology can scaffold complex learning processes, transforming PBL into a scalable, precise, and holistic education model that advances academic skills and social-emotional development in K-12 education.

12.2.3.2 Building an Innovative E-PBL Teaching System Within a Digital Education Ecosystem

This article explores the innovative Enhanced Project-Based Learning (E-PBL) smart teaching system developed by Shenzhen Mingde Experimental School within a digital education ecosystem framework. By integrating AI, big data, and cloud computing, the system scaffolds student learning across K-12 disciplines by shifting from passive, fragmented knowledge acquisition to a personalized, interactive, and student-centered approach.

At the heart of this scaffolding is the unified digital management platform, "Xiwo Magic Cube," which consolidates data from teaching, research, and student evaluations to enable real-time, data-driven decision-making. This platform supports smart lesson preparation and AI-powered assessments that provide personalized feedback, guiding students step-by-step through problem-solving and project-based tasks.

Technologies like ClassIn facilitate hybrid classroom interactions by monitoring student engagement and participation, while virtual labs such as Nobook offer safe, immersive environments for complex experiments. These tools collectively provide

scaffolds that help students build deeper understanding and core competencies through interactive, hands-on learning.

The system also scaffolds holistic development by delivering multi-dimensional evaluations through AI-generated reports on moral education and teacher performance analytics, enabling targeted support for both students and educators. While challenges remain in shifting traditional teaching mindsets and integrating technologies seamlessly, Mingde's E-PBL system exemplifies how technology can effectively scaffold learning processes, preparing future-ready learners and inspiring systemic educational reform.

12.2.3.3 Exploring Project-Based Learning in Elementary School Science Within a Smart Teaching Environment

This study investigates how project-based learning (PBL) integrated with smart teaching environments scaffolds deep learning and interdisciplinary competencies in elementary school science education. Conducted at Xiaode School in Shenzhen, it addresses the gap in research on technology-supported learning at the elementary level.

The authors propose a structured PBL framework that employs smart teaching tools to scaffold core scientific concepts and skills through personalized learning paths and cross-disciplinary collaboration. Two case projects illustrate this: in "Family Electrician," students use virtual labs and smart platforms to iteratively design and troubleshoot bedroom lighting circuits, receiving real-time feedback that guides their technical problem-solving. In "Seed Transformation," AR/VR tools immerse students in biological processes while supporting multimedia creation, scaffolding the integration of biology, art, and technology.

Technology facilitates resource integration, continuous formative assessment, and collaborative problem-solving, enabling teachers to shift from knowledge transmitters to learning facilitators. These tools provide scaffolds that adapt to students' needs, helping them build understanding progressively and engage more deeply with complex scientific tasks.

Challenges such as digital literacy disparities and uneven resource access remain, with future work aimed at refining technology use to promote equitable and holistic skill development. This research offers valuable insights into how smart environments can scaffold elementary science learning through PBL, modernizing education for the twenty-first century.

12.2.3.4 Innovative Exploration of Digital Project-Based Science Instruction in Elementary Schools Using Smart Education Platforms

This paper examines the innovative use of the iFlytek Smart Education Platform in elementary school science education, illustrating how technology functions as a

learning scaffold within a project-based learning (PBL) framework. Conducted at Shenyang Shangpin Dongjia School, the study showcases how digital tools provide structured, adaptive support to both students and teachers throughout the learning process.

Key platform features—including real-time surveys, VR/AR simulations, and AI-powered analytics—serve as scaffolding mechanisms that help teachers personalize instruction and students deepen their engagement. For example, voting tools identify high-interest topics like optics, guiding the launch of a periscope-making project that merges science concepts with hands-on inquiry. VR/AR tools offer immersive scaffolds for conceptual understanding, while voice-to-text discussions promote collaborative problem-solving.

Teachers leverage data dashboards to monitor learning progress and deliver targeted feedback through tools like experiment video reviews, enabling students to iteratively refine their scientific reasoning. Digital portfolios scaffold reflection and showcase individual learning trajectories. These supports significantly enhance student engagement and skill development—78% of students reported greater interest in science, and practical competencies were demonstrated through multimedia project outputs.

Teachers also experience technology as a professional scaffold: 85% reported improved digital literacy and more effective lesson co-design using shared online resources. While barriers such as VR/AR hardware costs persist, the platform effectively scaffolds both student autonomy and teacher decision-making, bridging pedagogical goals and technological affordances.

This case highlights how smart education platforms can act as dynamic scaffolds in PBL environments, fostering deeper, more personalized, and collaborative science learning in elementary education.

12.2.3.5 A Data-Driven Approach to Project-Based Learning in Junior Secondary Mathematics: A Case Study on Height Measurement

This paper explores data-driven project-based learning (PBL) in junior high mathematics through the "Height Measurement" project, illustrating how technology scaffolds students' mathematical modeling skills. Aligned with the Compulsory Education Mathematics Curriculum Standards (2022 Edition), the initiative integrates big data and smart learning tools to guide students systematically through modeling, data collection, analysis, and reflection.

At the foundational stage, school and district exam data reveal students' weaknesses in constructing and analyzing mathematical models, informing targeted scaffolding strategies. During implementation, the "Minzhi Homework" platform and smart pens collect detailed process data, enabling personalized feedback and formative support. For example, real-time analytics identify students' varying modeling abilities and provide tailored prompts to encourage multiple model designs and error analysis.

Technology scaffolds learning by structuring tasks based on authentic, real-life contexts, supporting hands-on activities, and facilitating peer collaboration. In the "Height Measurement" project, interactive group discussions on diverse measurement techniques are enriched through technology-enabled data sharing, promoting critical reflection on errors and model optimization. The digital tools help students incrementally develop flexible thinking and modeling literacy by offering immediate feedback, guiding revisions, and fostering autonomous inquiry.

This case exemplifies how technology serves as a scaffold in math education—organizing learning steps, providing personalized insights, and supporting collaborative problem-solving—thereby enhancing students' capacity to translate practical problems into mathematical models and refine their solutions.

12.2.3.6 Empowering Project-Based Learning in Elementary School English Through Digital-Intelligent Technologies: A Pathway Analysis

This paper investigates how digital intelligence technologies serve as learning scaffolds in elementary English project-based learning (PBL), with a focus on innovative practices at Shanghai Minhang Rose Elementary School. Through platforms such as the "Minzhi Platform" and tools like AI-powered pens, the study illustrates how technology provides adaptive, real-time support throughout the learning process.

Key scaffolding strategies include the use of KWH tables to visualize inquiry paths, AI-assisted feedback on pronunciation via interactive e-books, and the "Hamburger Method" to support structured writing. For instance, during a "traditional sports" project, smart pens captured student responses and flagged specific learning gaps—such as unfamiliarity with the term "shuttlecock"—enabling teachers to promptly intervene with targeted instruction.

The integration of technology is aligned with PBL phases: from engaging students in entry activities to guiding research and supporting final presentations. These tools scaffold both linguistic development and critical thinking. Real-time analytics allow teachers to adjust teaching based on performance trends, while students benefit from multimodal resources (e.g., AR, voice-to-text) that promote engagement and autonomous learning.

Results show clear improvements in student performance and motivation: 92% oral task accuracy, high-quality bilingual project outputs, and increased participation. Teachers, too, benefit from scaffolding in the form of automated grading analytics—reducing workload by 40% and enabling more personalized feedback.

While challenges such as over-reliance on technology persist, this approach demonstrates the effective use of digital tools as cognitive and procedural scaffolds in language learning. The model fosters autonomy, metacognitive awareness, and cultural literacy, offering a replicable framework for technology-enhanced PBL in English education and beyond.

12.2.3.7 Expanding Learning Pathways Through Artificial Intelligence and Cultural Inquiry: A Project-Based Case Study on "Travel" in Elementary School English

This paper presents a project-based learning (PBL) initiative in elementary English education at Shawan Huixian Elementary School, Guangzhou, where artificial intelligence (AI) and smart classroom technologies scaffold students' learning to promote Guangfu cultural awareness. Leveraging AI tools and digital platforms, the project supports fifth-grade students in exploring, researching, and presenting Guangfu culture within the theme of "Travel," aligned with the Compulsory Education English Curriculum Standards (2022 Edition).

The learning process is scaffolded through data-driven analysis and AI-assisted feedback. Teachers use Wenjuanxing surveys and iFlytek SparkDesk AI to identify student interests and language challenges, allowing tailored task design. In three stages—exploration, research, and promotion—technology acts as a cognitive and linguistic scaffold: students create hand-drawn maps, design travel plans with AI-assisted language support, and produce English videos as cultural ambassadors.

Key technological scaffolds include the National Smart Education Platform, Qinglu Smart Learning Platform, and iFlytek SparkDesk, which provide real-time feedback, intelligent content generation, and essay revision. These tools help students overcome language barriers by offering instant corrections and suggestions, enabling them to progressively build language competence and cultural understanding. Collaborative work is enhanced through interactive multi-screen devices, where AI-powered peer review fosters critical thinking and teamwork.

Formative assessment is integrated via platforms that track performance and provide detailed insights, allowing teachers to adjust support dynamically. The scaffolding effect of technology is evident in improved student English proficiency, cultural knowledge, and collaborative skills, with 92% of participants effectively introducing Guangfu culture in English.

This case exemplifies how technology can scaffold complex language learning by structuring tasks, providing personalized guidance, and facilitating meaningful cultural engagement. It demonstrates the transformative potential of smart classrooms to create immersive, data-informed learning environments that nurture both linguistic and cultural competence.

12.2.4 Designing for Real-World Impact

In an era defined by complexity, uncertainty, and rapid technological change, education systems are increasingly called upon to cultivate not only knowledge but also practical wisdom. Project-Based Learning (PBL), when anchored in authentic, real-world challenges, offers a powerful pathway to make learning meaningful, applicable, and future-ready. This section presents seven exemplary cases from across China that illustrate how PBL can be purposefully designed to address tangible societal needs,

ranging from personal health and environmental safety to smart urban innovation and digital citizenship. Across diverse grade levels and subject areas, these projects go beyond the acquisition of skills: they empower students to take ownership of problems that matter in their lives and communities. By integrating emerging technologies, interdisciplinary thinking, and student agency, these initiatives demonstrate how schools can become incubators of both learning and social contribution.

12.2.4.1 Teaching for Health Literacy: Design and Implementation of an Interdisciplinary "AI + Physical Education and Health" Project-Based Learning Approach

This paper presents an interdisciplinary project-based learning (PBL) model titled "AI + Physical Education and Health," developed at Wuling Experimental Elementary School in Suzhou, China, to tackle real-world issues of student physical and mental well-being. Through the project theme "Action for Physical and Mental Well-being," students used AI technologies—such as wearable sensors and smart data platforms—to monitor their health and receive tailored fitness feedback. Structured in four stages from inquiry to reflection, the model tasks students with designing personalized health plans and creating science-based fitness content.

The project fosters direct application of data-driven health tools, helping students adopt real-life habits such as sleep monitoring and stress management. It also integrates multiple disciplines, blending physical education with life sciences and IT, while training students to analyze and act on personal health data. Teachers benefit from AI-enhanced assessments, allowing for faster, more precise interventions. Outcomes include improvements in health literacy and physical competence, with clear evidence of student engagement and behavior change.

By addressing tangible student needs and aligning with China's 2022 curriculum reforms, this model exemplifies how education can be designed for meaningful, real-world impact. It demonstrates how emerging technologies can enhance personal agency, equity, and wellness in everyday student life—offering a replicable framework for broader educational transformation.

12.2.4.2 Design and Implementation of AI Project-Based Teaching in Middle School: A Case Study of the "Smart Family Piggy Bank"

This paper explores how designing learning experiences for real-world impact can empower junior high school students through an AI-based project, the "Family Smart Piggy Bank." Conducted at Wuhan Panlongcheng Economic Development Zone No.1 Middle School, the project addresses a genuine societal need—shared financial management among siblings—while fostering digital literacy and computational thinking. Grounded in national curriculum standards promoting project-driven

learning, the initiative challenges students to create an intelligent piggy bank using facial recognition, Mind + programming, and sensor technologies.

Students work in collaborative teams, engaging in all aspects of product design—from problem definition and planning to hands-on development and feedback. Technical components like the Huskylens visual sensor, ESP32 controller, and MP3 modules enable functions such as facial authentication and voice-based interaction. The process not only strengthens programming and AI tool use but also encourages creative problem-solving, iteration, and teamwork.

By tackling practical issues such as power supply and mechanical structure, students learn to refine their designs for real-world functionality. Beyond technical skills, the project promotes financial literacy and social values, demonstrating how technology education can intersect with everyday life. The experience exemplifies how purposeful, interdisciplinary learning can have a lasting impact on students' personal development and societal engagement, offering a replicable model for middle school AI education rooted in real-world relevance.

12.2.4.3 Curriculum Design for Innovation and Entrepreneurship Through 3D Printing Project-Based Teaching

This paper presents a forward-looking innovation and entrepreneurship curriculum from Qingdao No. 68 High School, designed to equip students with real-world skills through project-based learning in 3D printing and AI. Developed over six years within the Qingdao Education Bureau's Smart Education Demonstration Zone initiative, the curriculum merges advanced technology education with career readiness, interdisciplinary integration, and moral development.

Students engage in 13 authentic, scenario-based projects—from designing 3D-printed farm systems to constructing biomedical cell models—blending disciplines such as biology, art, and computer science. By forming simulated companies and applying tools like SolidWorks, AI, and VR, students gain hands-on experience in technical design, team collaboration, and entrepreneurial operations. Role assignments are guided by professional tools like MBTI and Holland interest inventories, helping align students' personal traits with practical tasks.

Beyond technical competence, the curriculum fosters innovation, collaboration, and digital literacy, aligning with global STEM trends and national policies promoting smart, interdisciplinary education. Student projects have won national awards, and the model supports participation in real science competitions, bridging academic learning with real-world innovation. Teachers also benefit professionally, contributing to broader STEAM initiatives and educational research (National Research Council, 2011).

This case demonstrates how purposeful curriculum design—centered on emerging technologies and authentic challenges—can prepare students not only for future careers but also for thoughtful, creative engagement with the complex problems of today's world.

12.2.4.4 A Cross-Platform Integrated Model for Innovative AI Education: A Case Study of "Listening to the World Outside"

This study proposes a cross-platform, project-based learning (PBL) model for AI education in elementary and secondary schools, designed explicitly to enhance real-world impact through accessible, emotionally resonant, and problem-centered learning. Moving beyond traditional hardware-bound approaches, the model allows students to explore authentic challenges from daily life and develop AI-driven solutions using open platforms like Qingdao E-platform and Mind+. This ensures inclusivity and adaptability, making AI learning more equitable and practically relevant.

The curriculum integrates STEAM disciplines and follows an "expand-contract-expand" learning arc: students begin with real-world observation, deepen understanding through tool-based experimentation, and conclude by presenting AI projects with tangible applications. In the featured case study, "Listening to the Outside World," students use sound sensors to connect AI with emotional literacy and sensory interpretation—bridging technical skills with human insight. The process fosters innovation, critical thinking, and public communication.

Additionally, the study demonstrates how integrating big data and process-based evaluations enables personalized learning paths and better captures student growth in modeling, reasoning, and interdisciplinary thinking. The initiative exemplifies how curriculum design can empower students to address complex, real-world problems creatively and meaningfully, preparing them to thrive in an AI-driven society.

12.2.4.5 A Smart Education Case of Problem-Oriented Python Teaching

This case study demonstrates how curriculum design grounded in real-world impact can cultivate both technical and social competencies in elementary school students. By embedding Python programming into authentic, problem-driven contexts, students gain not only coding skills but also a sense of responsibility for societal issues such as environmental safety. The integration of interdisciplinary content, collaborative learning, and purposeful technology use shows how foundational education can nurture informed, creative, and socially engaged problem-solvers.

The study adopts a problem-based learning approach to shift from traditional teacher-led instruction to student-centered exploration. Students work on meaningful projects, such as designing a "Smart Forest Fire Alarm System," which help them connect abstract programming concepts like loops and conditionals with real-life applications. Teachers support students through cycles of problem analysis, collaborative solution building, and iterative testing. Tools such as micro-videos, flowcharts, and group discussions help simplify complex tasks like integrating GPS with fire detection algorithms, making them manageable for young learners.

As a result, students develop computational thinking by learning to deconstruct problems, identify essential elements, and create automated solutions through code.

The project also strengthens interdisciplinary skills by linking programming with geography and civic education. Collaboration and creativity flourish through peer learning and open-ended challenges, such as optimizing alarm performance, which encourage innovation and teamwork.

Despite its successes, the study reveals some challenges. Students sometimes struggle to transfer previous knowledge to new contexts, signaling a need for stronger scaffolding. While AI tools enhance learning, overuse can hinder independent thinking, so guided use is emphasized. Evaluation through rubrics involving self, peer, and teacher assessments is effective but could better reflect the iterative nature of learning.

Overall, this initiative exemplifies how coding education rooted in real-world challenges can go beyond technical instruction to foster broader cognitive and social growth. With further development, such programs can become even more inclusive and impactful, better preparing students for future interdisciplinary and community-oriented problem-solving.

12.2.4.6 Design and Implementation of Project-Based Learning in Elementary School Information Technology from a Big-Unit Perspective

This study explores how macro-unit project-based learning (PBL) in elementary information technology education can be designed for real-world impact by cultivating digital fluency and interdisciplinary problem-solving skills. Conducted at Guangdong Second Normal University Affiliated Nansha Experimental Elementary School, the initiative responds to limitations in traditional IT teaching, which often prioritizes technical drills over practical, meaningful application.

By restructuring textbook content into thematic macro-units—such as "Online Life" and "Online Creation"—the curriculum immerses students in projects that mirror real-life digital experiences. In "My Digital Life," for instance, students engage in tasks like web navigation and data management, which prepare them for responsible and competent digital participation in society.

The pedagogical model emphasizes student agency, teacher facilitation, and a balanced assessment system combining peer review, reflection, and formative evaluation. The integration of subjects like science, art, and ethics highlights how digital tools intersect with broader societal themes. Implementation challenges remain, including teacher readiness and curriculum coherence, but the outcomes clearly demonstrate that macro-unit PBL fosters not only technical skills, but also collaboration, creativity, and critical digital citizenship.

This case presents a scalable approach to information technology education that bridges theory with application and equips students with the competencies to engage in a rapidly evolving digital world—reflecting the essence of designing for real-world impact.

12.2.4.7 Implementation Experiences and Challenges of Specialized Information Technology Courses in General High Schools: A Case Study of Beijing Normal University Affiliated High School

Beijing Normal University Affiliated High School has restructured its high school information technology curriculum to design learning experiences with tangible, real-world impact. Through a modular and project-based model, students engage with practical challenges such as building intelligent vehicles, developing smart campus tools, and simulating smart city solutions. These projects encourage the application of AI, open-source hardware, and algorithmic thinking to authentic, socially relevant scenarios, fostering creativity, critical thinking, and innovation.

Aligned with national standards yet deeply responsive to student interests, the curriculum offers a flexible framework that connects foundational IT skills with interdisciplinary learning. Modules like AI fundamentals, 3D design, and programming creativity allow students to choose pathways that match both personal interests and real-world relevance. Teaching is organized around large-unit instruction and exploratory tasks, enabling students to work collaboratively and tackle practical problems with meaningful outcomes.

While exam-oriented constraints present scheduling challenges, the school has proposed structural changes to ensure sustained engagement and better integration with national innovation competitions. The initiative not only advances students' digital competencies but also empowers them to become proactive contributors to an innovation-oriented society. It also promotes teacher development by embedding them in ongoing curriculum design and pedagogical refinement.

This reform demonstrates how thoughtful curriculum design can bridge academic learning and societal needs, ensuring that IT education prepares students not just for exams, but for solving complex challenges in the real world.

12.3 Implications for Practice and Policy

The diverse practices showcased across these four themes point toward several key implications for educators, school leaders, and policymakers seeking to embed PBL more deeply and effectively in China's evolving education landscape.

First, purposeful curriculum design is essential. Whether the goal is fostering real-world impact, nurturing creativity, or empowering student agency, the most effective cases intentionally align project content, learning outcomes, and assessment strategies. This alignment enables students to experience coherence across their learning journey, moving from exploration to creation to reflection. Research by Thomas (2000) emphasizes that successful project-based learning hinges on well-structured curricula that connect meaningful tasks with clear assessment, promoting deeper student engagement and understanding. Policymakers and curriculum developers should prioritize frameworks that integrate interdisciplinary thinking with authentic

tasks, ensuring that learning remains both meaningful and transferable (Barron & Darling-Hammond, 2008).

Second, teacher capacity building must be systemic and sustained. Teachers play a pivotal role in mediating student voice, designing scaffolds, and managing complex projects. Many successful examples in this volume come from schools with strong professional learning communities, robust mentorship systems, and access to training in smart pedagogy. Scaling PBL requires investment in ongoing teacher development, including support in instructional design, technology integration, and formative assessment strategies.

Third, technology should serve as a dynamic scaffold, not a driver. Across science, language, and arts classrooms, digital tools enhance rather than replace human-centered teaching and learning. Platforms that provide personalized feedback, support collaboration, and visualize learning trajectories can make PBL more accessible and inclusive. However, attention must be paid to balancing automation with human judgment, especially in guiding student inquiry and maintaining emotional connection. Research in educational technology emphasizes that technology acts best as a scaffold to support cognitive and social processes rather than to supplant the teacher's role (VanLehn, 2011). Moreover, studies show that personalized feedback through digital platforms can significantly improve student engagement and learning outcomes when integrated thoughtfully with teacher facilitation (Shute, 2008). Importantly, human judgment remains critical to mediate the emotional and inquiry-driven aspects of learning, ensuring technology complements rather than dominates educational experiences (Dede, 2014).

Fourth, assessment reform is critical. The most impactful cases rethink assessment as formative, process-oriented, and multi-sourced. From digital portfolios and peer feedback to real-time analytics and community exhibitions, these varied methods capture student growth more authentically than traditional tests. System-wide reform should embrace this shift by developing tools and policies that legitimize diverse forms of evidence for learning and development.

Finally, equity and relevance must remain at the center. The success of PBL hinges on its connection to students' lives, whether that means designing health interventions, exploring cultural identity, or building smart cities. Projects should be locally grounded and personally meaningful, allowing all students, regardless of background, to contribute to and benefit from the learning experience.

In summary, the cases presented in this volume do not just illustrate what PBL looks like in action. They reveal what is possible when pedagogy, policy, and practice converge. By investing in thoughtful curriculum, empowered teachers, and inclusive innovation, China and the global education community can unlock the full potential of project-based learning to shape future-ready learners.

12.4 Conclusion

This chapter has shown how PBL is being used across China to create more engaging, student-centered classrooms. Through real examples, we explored how PBL promotes learner agency, encourages creativity across subjects, integrates technology, and connects learning to real-world problems.

These cases demonstrate that PBL is not one fixed model but a flexible approach that responds to learners' needs and school contexts. When well-designed, PBL can transform education into a process of discovery, reflection, and meaningful action.

As schools and systems seek deeper, more relevant learning, these stories offer practical models of how PBL can support both student growth and broader educational goals.

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