

A Study of Project-Based Learning in Primary Mathematics: Teaching Design for the “Synthesis and Practice” Domain— — *Taking the “Mathematical Games” Unit from the First-Grade (Upper Semester) Textbook of the People’s Education Press as an Example*

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Abstract: China’s *Curriculum Standards for Compulsory Education (2022 Edition)* call for authentic contexts and exploratory activities in the “Synthesis and Practice” domain of primary mathematics. Project-based learning (PBL) provides an effective pathway to meet these requirements. Based on this, a project-based learning teaching design case was constructed centering on the lesson “Mathematical Games” in the first-grade (upper semester) textbook. With the theme of “Hello, My Campus”, the case unfolds around four tasks: campus observation, collaborative games, creative product making, and presentation & reflection—integrating mathematics with language, physical education, and the arts. By emphasising inquiry, cooperation, and cross-disciplinary learning in real-world settings, the approach supports pupils’ smooth transition into primary school life and offers a replicable model for “Comprehensive Practice and Activity Curriculum” teaching in the lower grades.

Keywords: Primary school Mathematics; Project-based learning; Synthesis and Practice

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1.Introduction

Project-based learning is a learner-centred approach that engages pupils in hands-on inquiry within authentic contexts, enabling them to apply knowledge from multiple subjects to solve meaningful problems. In primary mathematics, the “Synthesis and Practice” domain has become a key driver of curriculum reform, aiming to cultivate core mathematical literacy while building interdisciplinary learning capabilities. With the implementation of the 2022 standards, instruction increasingly values active participation and practical experience. The features of PBL closely align with the goals of the “Synthesis and Practice ” domain, making its incorporation into primary mathematics both timely and significant. This paper, therefore, adopts the People’s Education Press (PEP) Year 1, Semester 1 unit “Mathematical Games” as a case, exploring how PBL can be enacted in the domain and proposing a concrete instructional design for classroom practice.

2.The Necessity of Project-Based Learning

Applying PBL to “Synthesis and Practice” teaching is necessary both to align with the direction of the 2022 standards and to suit the nature of the content.

2.1 Trends under the New Curriculum Standards

The 2022 standards substantially update the “Synthesis and Practice” domain to meet contemporary educational goals. The domain is re-positioned to emphasise core disciplinary competencies and to promote integrated pedagogy. It directly responds to the “curriculum integration and subject integration” requirements in the *Compulsory Education Curriculum Framework (2022 Edition)*. The standards specify the allocation of teaching time, requiring that comprehensive/practical learning comprise no less than 10% of total teaching hours per semester. They also clarify activity categories, provide teaching suggestions for thematic activities, and explicitly recommend organising

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learning through thematic and project-based approaches ^[1].

PBL's advantage lies in creating open, exploratory learning environments that guide pupils to investigate actively, build self-directed learning habits, and deepen conceptual understanding. Integrating PBL into primary mathematics, therefore, operationalises the standards' expectations for comprehensive and practical activities while enriching pupils' learning experiences.

2.2 Suitability of Project-Based Learning for the “Synthesis and Practice” Domain

Themes in this domain are rich and varied. By format, activities can be grouped into six types: game-based activities, hands-on manipulation, research projects, language-based descriptions, surveys/interviews, and scenario observations ^[2]. From the perspectives of theme type and knowledge integration, prior work summarises three broad categories: primarily cross-disciplinary practical knowledge; primarily integrated application of mathematical knowledge; and primarily activities that embed mathematical knowledge learning ^[3].

Despite differences in classification, PBL fits these activities well because it stresses authentic contexts, driving questions, and interdisciplinary inquiry. It naturally integrates mathematics with other subjects and guides pupils to solve problems in real-world settings, enabling them to experience the appeal and utility of mathematics. In the first learning stage, for example, “mathematical games”, “understanding Renminbi units”, “recognising hours, minutes and seconds”, and “identifying basic directions” all foreground mathematical knowledge while inviting integration with language, PE, and the arts. Teachers can draw on the 2022 standards and existing resources to design PBL themes that realise the curriculum objectives.

3. Case: Project-Based Learning Design for “Synthesis and Practice” Using the Unit “Mathematical Games”

With the rollout of the 2022 standards, primary mathematics places greater emphasis on integrated, practice-oriented learning in real contexts. Against this backdrop, this study designs a PBL sequence based on the PEP Primary Mathematics Year 1, Volume 1 unit “Mathematical Games”. As pupils' first mathematics lesson in primary school (page 1 of the textbook), this unit supports the transition from kindergarten to primary education and helps establish a positive first impression of mathematics. In the latest edition, the title changes from “Preparation Lesson” to “Mathematical Games”, and the length expands from five to eleven pages, underscoring the importance of the first “Comprehensive Practice and Activity Curriculum” activity. Building on textbook analysis, the design adopts the PBL theme “Hello, My School”.

3.1 Project Background and Objectives

3.1.1 Student Profile

The first-grade pupils are lively and curious, rely on concrete imagery, and have developing self-awareness. Their attention is easily diverted and often lasts only 10–15 minutes; game-based, activity-centred learning is therefore appropriate. Having just entered primary school, pupils are still forming learning habits and may feel unfamiliar with their environment and peers. Collaborative PBL can support rapid social integration.

3.1.2 Textbook Analysis

The “Mathematical Games” unit unfolds across six themes: Welcoming New Pupils (familiarising with school and role transitions); Exploring the School Grounds (recognising campus features); Playing on the Playground (e.g., “Peach Blossoms in Bloom”); Getting to Know the Classroom (exploring the space and self-introductions); Playing in the Classroom (e.g., “I Say, You Do”); and Preparing for Learning (establishing routines). These themes progressively familiarise pupils with school settings and interweave mathematical ideas across “Number and Algebra”, “Shape and Geometry”, and “Statistics and Probability”, highlighting game-based, activity-centred learning.

3.1.3 Objectives

Aligned with the curriculum and core competencies for the first stage of primary education, the project pursues three objectives:

- (1) Transition and adaptation: Through school tours, classroom familiarisation, and peer interaction, help pupils understand the school environment, reduce anxiety, and smoothly adapt to primary-level learning and routines.
- (2) Early mathematical literacy: Building on prior experience, enable pupils to represent quantities, describe order (e.g., "which one is next"), name simple shapes, and correctly count up to ten. Introduce one-to-one correspondence for comparing quantities and their values.
- (3) Communication and collaboration: Through group discussion and joint product creation, develop practical skills, oral expression, and cooperative learning.

3.2 Project Tasks

3.2.1 Task Structure

Under the theme “Hello, My School”, the PBL sequence comprises two sections—“Observing the School” and “Collaborative Games”—and four tasks.

Task 1 (Planning): In groups, pupils clarify project goals and decide on presentation formats through whole-class discussion.

Task 2 (Observation): Guided by the teacher, pupils tour the campus and complete observation sheets focusing on three types of information: Geometric features (to strengthen shape recognition); Numbers and data (e.g., class size and composition); Spatial relations (e.g., seating arrangements) are used to develop positional awareness.

Task 3 (Playground games): Queuing to grasp ordinal concepts (e.g., “Which number am I in line?”), comparing heights to perceive relative quantities, and playing “I say, you do” to practise spatial orientation and following instructions. These activities reduce newcomers’ anxiety and build cooperation.

Task 4 (Creation & sharing): Groups create campus-themed products (e.g., posters, models, or short videos), present them, and engage in reflection through self-assessment, peer review, and teacher feedback.

These tasks integrate mathematical, linguistic, physical, and artistic elements, illustrating the interdisciplinary nature of PBL (see Figure 1 for a schematic correspondence).

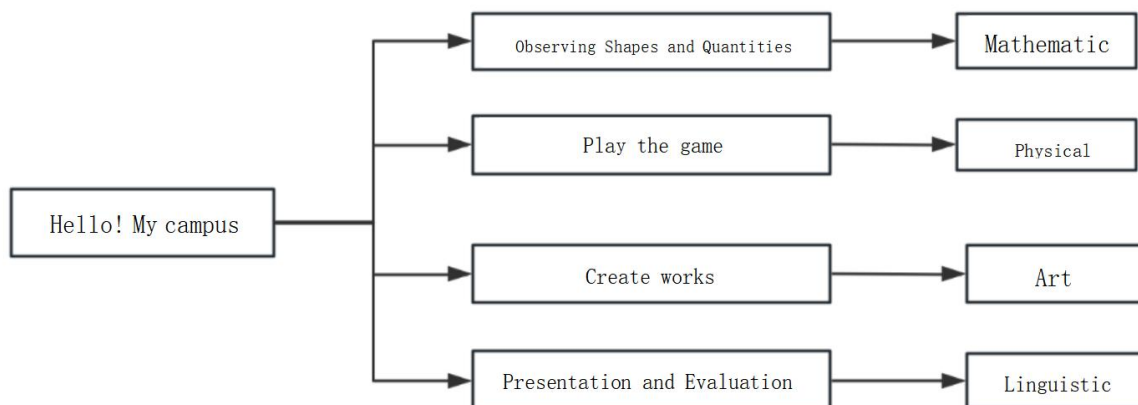


Figure 1 Correspondence between Project Tasks and Subject Elements in “Hello, My Campus”

3.2.2 Learning Scaffolds

Teachers act as organisers, facilitators, and co-learners. They provide scaffolds to help pupils record observations, identify mathematical elements in activities, and complete their creative products. In the first learning stage, scaffolds should match pupils’ literacy and motor development; demonstrations and verbal explanations are essential, and pupils may respond through drawings, symbols, or manipulative work rather than extended writing. A

sample “Campus Observation Record” (Table 1) structures data collection for later creation while enabling teachers to gauge pupils’ prior knowledge.

Table 1 Campus Observation Record (sample prompts)

1. My name is _____. My seat is in front of _____. To my left sits _____. When lining up in the classroom, I am in position _____. 2. Our class has _____ pupils: _____ boys and _____ girls. 3. The school has _____ year groups. Each year group has _____ classes. I am in Year _____, Class _____. 4. Shapes I can see around me include: _____.
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3.3 Sequencing Lessons and Refining Tasks

A suggested sequence is: one lesson for a class meeting to introduce the project; two lessons for observation and games; two lessons for collaborative creation; and two lessons for sharing and exhibition.

Lesson 1 (Launch): Use driving questions—e.g., “You are now a primary school pupil. How might we introduce our school to your family?”—to spark brainstorming. Play “What’s in the School?” to introduce the observation checklist. Use a train-style self-introduction mini-game to build rapport. Observe the classroom and complete the record sheet. Form groups and discuss the final deliverable and presentation format.

Lesson 2 (Observe—classroom & peers): Identify shapes of objects, count pupils, compare the numbers of boys and girls, and discuss seating orientation. Move outdoors to explore mathematics around the campus, record findings, and familiarise pupils with the new environment.

Lesson 3 (Playground games): Organise queueing, height comparison, and “I say, you do” to blend movement with mathematics. Pose prompts such as “What number are you in the line?” and “How do we compare heights?” to sustain inquiry while pupils complete their observation sheets.

Lessons 4–5 (Create): In groups, use recorded data to produce posters, models, or short videos. The teacher circulates to offer formative feedback on process and product.

Lessons 6–7 (Share & reflect): Organise group presentations. To support younger pupils’ expression, provide sentence frames or key points. Facilitate peer questions and reflections.

3.4 Assessment

Assessment is integral to PBL. After each sub-task, use tools for formative evaluation alongside self- and peer assessment. At the end of the project, hold an exhibition or record short videos to showcase products and reflections. Guiding questions may include: “Whom did you most admire, and why?” “How does primary school life differ from kindergarten?” “What habits should we develop for future learning?” Such prompts encourage metacognition and help establish classroom routines. Multi-dimensional assessment also enables teachers to refine instruction and monitor engagement, while self- and peer evaluation help pupils recognise their contributions and strengthen group cohesion.

4. Conclusion

Guided by the Compulsory Education Curriculum Framework (2022 Edition), this study presents a feasible approach to thematic teaching in the lower grades through the PBL case “Hello, My School”, situated in the “Mathematical Games” unit of the “Synthesis and Practice” domain. The case encompasses student profiling, textbook analysis, objective setting, task design, learning scaffolds, and formative assessment to form a coherent PBL framework. Implementing this design helps pupils integrate into primary school life, notice mathematical phenomena in everyday contexts, develop practical skills and oral expression, cultivate collaboration, and experience the joy of mathematics through hands-on activities. Its interdisciplinary integration aligns with the requirements of the new standards and provides a useful reference for subsequent teaching practice.

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