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Problem-Based Learning and Higher-Order Thinking Skills in Chinese Higher Education: A Conceptual Review and Pedagogical Framework

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Abstract **Review Article**

Developing higher-order thinking skills has become a central goal of higher education because universities are increasingly expected to prepare students for complex problem solving, independent learning, communication, collaboration, and lifelong development. Problem-based learning offers a student-centered pedagogy in which learners engage with authentic problems, conduct inquiry, collaborate with peers, and reflect on possible solutions. Although the value of problem-based learning has been discussed across educational contexts, its application in Chinese higher education still faces contextual constraints, including teacher-centered classroom traditions, examination-oriented assessment, limited student experience with self-directed learning, and insufficient process-based evaluation. Based on a conceptual synthesis of literature on higher-order thinking skills, problem-based learning, constructivist learning theory, Barrows' PBL model, and the 3C3R problem design model, this article develops a pedagogical framework for using problem-based learning to support higher-order thinking skills in Chinese college classrooms. The article argues that problem-based learning can support students' critical thinking, creativity, problem-solving ability, communication, and collaboration when it is implemented through authentic problem design, progressive learning scaffolds, structured group work, teacher facilitation, and multidimensional assessment. The article contributes a context-sensitive framework for educators who seek to shift from knowledge transmission to ability-oriented teaching in higher education.

Keywords: problem-based learning; higher-order thinking skills; Chinese higher education; conceptual review; pedagogical framework.

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1. INTRODUCTION

Higher education is increasingly expected to prepare students not only to acquire knowledge but also to use knowledge in uncertain, complex, and changing situations. In many policy and curriculum discussions, this expectation is expressed through the language of higher-order thinking skills (HOTS), which can be traced to the cognitive levels of Bloom's taxonomy and later revisions that emphasize analysis, evaluation, and creation (Bloom, 1956; Anderson & Krathwohl, 2001; Krathwohl, 2002). In the information and artificial intelligence era, the need to reassess educational objectives has become even more visible because students must interpret

information, evaluate evidence, and produce reasoned responses rather than merely reproduce content (AlAfnan & Al, 2024). HOTS generally refers to cognitive and social capacities that go beyond remembering and understanding. It includes the ability to analyze information, evaluate evidence, create solutions, communicate ideas, collaborate with others, and solve unfamiliar problems. These capacities are particularly important for college students because they are approaching the transition from formal education to professional and civic life.

The need for HOTS is especially visible in the context of Chinese higher education. Chinese students are often recognized for strong mastery of basic knowledge, yet many classrooms continue to be shaped by teacher-centered instruction, textbook-based learning, and examination-oriented evaluation. Studies of Chinese and Chinese-related pedagogical settings have shown that adapting learner-centered approaches requires attention to local classroom traditions, teacher roles, and assessment expectations (Li et al., 2012). More broadly, education reform aimed at competitiveness and innovation has encouraged systems to move beyond knowledge transmission toward deeper learning and higher-order thinking (Sahlberg, 2006; Zohar, 2013). These practices can support knowledge coverage and procedural accuracy, but they may provide limited opportunities for students to question assumptions, compare alternative explanations, design solutions, and reflect on their reasoning. As a result, the cultivation of HOTS requires not only adding new content to existing courses but also reconsidering how learning activities are designed and assessed.

Problem-based learning (PBL) offers one possible response to this challenge. PBL begins with a problem rather than a lecture, a principle that emerged from medical education and was later extended across educational contexts (Barrows & Tamblyn, 1980; Schmidt, 1983; Barrows, 1996). Students work with an authentic or semi-authentic situation, identify what they need to know, search for and evaluate information, discuss possible explanations, and present or revise a solution. The teacher does not disappear from the classroom; rather, the teacher becomes a facilitator who organizes the learning environment, asks productive questions, provides timely scaffolds, and guides reflection (Savery, 2006; Hmelo-Silver, 2004). In this sense, PBL is not merely a classroom technique. It represents a shift from transmission-oriented teaching to inquiry-oriented and ability-oriented learning.

Although many studies have examined the benefits of PBL in various fields, the direct transfer of PBL into Chinese college classrooms is not straightforward. Reviews and meta-analyses suggest that PBL can support learning outcomes, problem solving, retention, and professional competencies, but its effects vary according to outcome type, problem design, facilitation quality, and assessment method (Albanese & Mitchell, 1993; Vernon & Blake, 1993; Dochy et al., 2003; Strobel & van Barneveld, 2009). Students who are accustomed to lecture-based learning may initially feel uncertain when they are asked to define learning goals or negotiate solutions with peers. Teachers may also face difficulty in designing ill-structured problems, managing group discussion, and assessing learning processes rather than only final answers. These tensions have been noted in PBL research and indicate that implementation is a design problem rather than a simple matter of adopting a new label (Hung et al., 2003; Boud & Feletti, 2013). These issues suggest that PBL needs to be adapted to the cultural, institutional, and classroom realities of Chinese higher education.

This article does not report empirical data. Instead, it develops a conceptual review and pedagogical framework for understanding how PBL may support HOTS in Chinese higher education. The article addresses three questions: First, what is the conceptual relationship between PBL and HOTS? Second, what contextual challenges may affect the implementation of PBL in Chinese college classrooms? Third, what pedagogical framework can guide teachers who wish to use PBL for HOTS development? By answering these questions, the article aims to provide a practical and theoretically grounded foundation for later empirical work.

2. RESEARCH METHOD

This article is designed as a conceptual review rather

than a systematic review or an empirical study. The analysis draws on literature concerning HOTS, PBL, constructivist learning theory, PBL problem design, and the Chinese educational context. The purpose is not to estimate an overall effect size or to make a causal claim about PBL outcomes. Instead, the article synthesizes theoretical and pedagogical arguments to develop a framework that can guide classroom implementation and future empirical research.

The synthesis was organized around three analytical steps. First, key concepts were clarified, especially HOTS and PBL. Second, the theoretical link between PBL and HOTS was examined through constructivist learning theory, Barrows' PBL model, and Hung's 3C3R model. Third, the framework was contextualized for Chinese higher education by considering teacher-centered traditions, students' learning habits, classroom organization, and assessment practices. This approach is appropriate at the present stage because quantitative data have not yet been collected, while the theoretical and pedagogical foundations are already sufficiently developed to support a literature-based article.

3. RESULTS AND DISCUSSION

3.1 Higher-Order Thinking Skills in Higher Education

HOTS is often discussed in relation to Bloom's taxonomy of educational objectives, in which analysis, evaluation, and creation are placed above remembering, understanding, and applying (Bloom, 1956; Krathwohl, 2002). This hierarchical view remains useful because it reminds educators that learning is not limited to the reproduction of information. The revised taxonomy further clarifies the relationship between knowledge types and cognitive processes, which is helpful for designing college learning outcomes and assessments (Anderson & Krathwohl, 2001). However, HOTS should not be reduced to a simple ladder of cognitive difficulty. In real learning situations, students often move back and forth among understanding, applying, analyzing, evaluating, and creating. For example, solving a complex problem may require remembering relevant concepts, applying procedures, comparing evidence, judging alternatives, and generating a new solution. Recent discussions of taxonomy in technology-rich and artificial-intelligence-rich environments also suggest that students need to engage with cognitive objectives flexibly rather than mechanically (AlAfnan & Al, 2024).

Resnick's description of higher-order thinking is particularly helpful for higher education. Higher-order thinking is non-algorithmic, complex, effortful, self-regulated, and often involves uncertainty (Resnick, 1987). It may produce multiple solutions rather than one correct answer. It requires judgment, interpretation, and the application of multiple criteria that may sometimes conflict with one another. These features fit the learning goals of higher education because professional and social problems rarely appear as simple exercises with fixed answers.

In this article, HOTS is understood as a multidimensional set of abilities that includes critical thinking, creativity, problem-solving skills, communication skills, and collaboration skills. Critical thinking refers to the ability to examine claims, evidence, assumptions, and implications. Creativity refers to the ability to generate original or useful ideas, perspectives, or solutions. Problem-solving skills refer to the ability to identify problems, analyze conditions, develop strategies, and evaluate results. Communication skills refer to the ability to express reasoning clearly and respond to others' perspectives. Collaboration skills refer to the ability to work with peers, negotiate meaning, and develop shared solutions. Research on the deliberate teaching of higher-order thinking also indicates that these abilities require purposeful instructional design rather than incidental exposure to difficult content (Miri et al., 2007; Zohar, 2013). These dimensions are interrelated rather than isolated. A student solving a real problem may need to communicate ideas, question evidence, collaborate with peers, and revise a solution creatively.

For higher education, the value of HOTS lies in its connection with deep learning and transfer. Students who possess HOTS are more likely to understand why knowledge matters, how knowledge can be used, and how knowledge can be questioned or extended. Learning sciences research emphasizes that meaningful learning depends on connecting new

ideas with prior knowledge, engaging actively with tasks, and applying knowledge in new situations (Bransford et al., 1999). Higher education teaching should therefore align intended learning outcomes, learning activities, and assessment tasks so that students are encouraged to develop transferable understanding rather than isolated recall (Biggs et al., 2022). Evidence from active learning research also suggests that students benefit when they are required to discuss, solve, explain, and apply ideas rather than only listen to lectures (Prince, 2004; Freeman et al., 2014). Therefore, teaching for HOTS requires learning activities that expose students to meaningful problems and require them to make reasoned decisions.

3.2 Problem-Based Learning as Student-Centered Pedagogy

PBL is a student-centered pedagogy that organizes learning around problems. Unlike conventional instruction, where teachers usually present content first and students apply it later, PBL begins with a problem that creates a need for learning. Students then identify what they know, what they need to learn, and how they might proceed. This process encourages learners to become active participants in knowledge construction rather than passive recipients of information (Barrows & Tamblyn, 1980; Schmidt, 1983).

Several features distinguish PBL from ordinary classroom questioning. First, the problem is usually ill-structured or open-ended. It does not have a single predetermined answer, and students must define the problem space before proposing a solution. Second, learning is self-directed but not unsupported. Students are expected to search for information and manage learning tasks, while teachers provide scaffolding and guidance. Third, PBL is collaborative. Students usually work in groups, share interpretations, challenge one another's reasoning, and construct joint explanations. Fourth, reflection is central. Students are encouraged to evaluate not only the final solution but also the process through which the solution was developed (Hmelo-Silver, 2004; Savery, 2006; Jonassen, 2003).

Barrows' model of PBL emphasizes reasoning, self-directed learning, collaboration, student-centeredness, and reflective habits (Barrows, 1986, 1996). These elements show that PBL is not only about solving a problem but also about developing the habits of mind needed to approach unfamiliar problems. PBL was later expanded beyond medical education into school and college settings, including secondary education and K-12 curriculum design (Barrows & Kelson, 1995; Torp & Sage, 1998). Hung's 3C3R model further strengthens the design dimension of PBL. The three core components are content, context, and connection, while the three processing components are researching, reasoning, and reflecting (Hung, 2006). Together, these components remind teachers that an effective PBL problem must be aligned with curriculum goals, embedded in a meaningful context, connected to students' prior knowledge and future application, and structured to promote inquiry, reasoning, and reflection.

PBL therefore provides a strong pedagogical basis for HOTS development. When students face a meaningful problem, they must analyze the situation, identify gaps in their knowledge, search for and evaluate evidence, communicate with peers, and justify their decisions. These processes correspond closely to the major dimensions of HOTS. However, this connection should be treated as a pedagogical potential rather than an automatic outcome. Reviews of PBL show both promise and variation, while critiques of minimally guided instruction warn that novice learners may struggle when guidance is insufficient (Albanese & Mitchell, 1993; Vernon & Blake, 1993; Kirschner et al., 2006). Later responses and facilitator-focused studies clarify that well-designed PBL is not unguided discovery; it depends on scaffolding, collaborative knowledge building, and purposeful facilitation (Hmelo-Silver & Barrows, 2008). Poorly designed PBL may lead to superficial discussion, unequal group participation, or confusion. The effectiveness of PBL depends on problem quality, teacher facilitation, student readiness, and assessment alignment.

Table 1. Conceptual Alignment between PBL Processes and HOTS Dimensions

PBL process	Learning activity	HOTS dimension supported	Teacher support
Problem encounter	Students interpret an authentic or ill-structured problem.	Problem identification; analytical thinking	Clarify context and learning goals without giving direct answers.
Inquiry and research	Students search for information and compare possible evidence.	Critical thinking; information evaluation	Recommend credible sources and ask evidence-based questions.
Group discussion	Students exchange interpretations and negotiate possible solutions.	Communication; collaboration; reasoning	Monitor participation and guide deeper discussion.
Solution development	Students design, justify, and revise proposed solutions.	Creativity; problem-solving; evaluation	Encourage alternative explanations and feasibility checks.
Reflection	Students evaluate what they learned and how they learned it.	Metacognition; self-regulation	Use reflection prompts and process-based feedback.

3.3 Theoretical Link between PBL and HOTS

The relationship between PBL and HOTS can be explained through constructivist learning theory. Constructivism views learners as active participants who build knowledge through experience, interaction, and reflection. From this perspective, meaningful learning occurs when students connect new information with prior knowledge and revise their understanding through activity (Bransford et al., 1999; Savery & Duffy, 1995). PBL reflects this view because students learn through engagement with problems, not simply through reception of finished explanations.

The first theoretical link is authenticity. HOTS is most likely to be activated when students face tasks that are complex enough to require judgment. Authentic problems create uncertainty and require students to examine conditions, compare options, and justify their decisions. Problem representation is itself an important part of problem solving because learners must understand the situation before choosing a strategy (Jonassen, 2003). Hung's 3C3R model similarly emphasizes that problem quality depends on content, context, connection, researching, reasoning, and reflecting (Hung, 2006). This moves learning beyond recall and encourages students to apply knowledge in meaningful contexts. In Chinese higher education, authenticity is especially important because it can help students see the relevance of course knowledge to future professional and social situations.

The second link is inquiry. PBL requires students to ask questions, identify knowledge gaps, and seek information. This process promotes critical thinking because students must decide what information is relevant, whether sources are credible, and how evidence supports or weakens a possible solution. Inquiry also supports problem-solving because students learn to break down a complex situation into manageable tasks. The psychological basis of PBL emphasizes activation of prior knowledge, elaboration, self-directed study, and restructuring of understanding through discussion and feedback (Schmidt, 1983; Norman & Schmidt, 1992; Hmelo-Silver, 2004).

The third link is dialogue. HOTS is not only an individual cognitive process; it is also socially developed through discussion. When students

explain ideas to peers, encounter disagreement, or defend a position, they are pushed to clarify their reasoning. Dialogue can expose assumptions and encourage students to reconsider premature conclusions. Studies of PBL facilitation show that tutor questioning and collaborative knowledge building can help students move from fragmented ideas toward shared explanations (Hmelo-Silver & Barrows, 2008). In this way, group discussion becomes a site for reasoning rather than merely a division of labor.

The fourth link is reflection. Reflection enables students to examine both what they have learned and how they have learned it. Without reflection, students may complete a project but fail to develop transferable thinking strategies. Barrows' taxonomy of PBL methods and later PBL scholarship both treat reflective and self-directed learning as central to the method rather than peripheral additions (Barrows, 1986; Boud & Feletti, 2013). Reflection also supports constructive alignment because it helps students connect learning processes, learning outcomes, and assessment criteria (Biggs et al., 2022). Therefore, reflection should be designed as an explicit component of PBL rather than treated as an optional activity at the end of class.

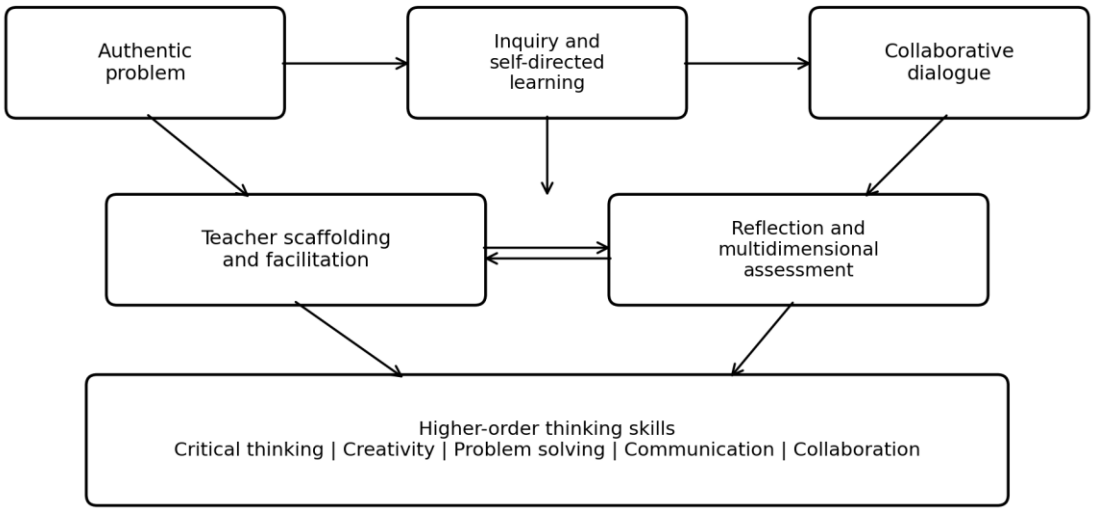


Figure 1. Pedagogical mechanism linking PBL to HOTS development

3.4 Challenges in the Chinese Higher Education Context

The implementation of PBL in Chinese higher education should be understood as a context-sensitive process. PBL was developed and widely used in settings where small-group learning, open discussion, and student autonomy are often more institutionally supported. In many Chinese college classrooms, however, teaching and learning are still influenced by long-standing expectations about teacher authority, curriculum coverage, and examination performance. Research on the adaptation of Western pedagogies in Chinese-related contexts suggests that imported student-centered methods must be interpreted through local cultural, institutional, and classroom conditions (Li et al., 2012). Educational reform literature also shows that moving toward higher-order thinking across a system

requires more than policy language; it requires classroom-level support, teacher development, and assessment change (Sahlberg, 2006; Zohar, 2013). These conditions do not make PBL impossible, but they require careful adaptation.

One challenge is the persistence of teacher-centered instruction. In many classrooms, the teacher is expected to explain the textbook, organize the pace of learning, and provide authoritative answers. Students may therefore understand learning as listening, recording, and reproducing knowledge. PBL changes this relationship by asking students to define problems and construct solutions. This shift may create uncertainty for both teachers and students. Teachers may worry that discussion reduces content coverage, while students may worry that open-ended tasks do not directly prepare them for examinations. Constructive alignment is therefore important: if course objectives and assessments still reward only recall, students and teachers have little reason to sustain problem-based inquiry (Biggs et al., 2022).

A second challenge is students' limited experience with self-directed learning. PBL assumes that learners can identify learning needs, search for information, manage time, and evaluate sources. These abilities are themselves learning outcomes, not preconditions that all students already possess. If students are asked to conduct independent inquiry without support, they may become confused or disengaged. This is the strongest lesson from the debate over minimal guidance: students need structured support when they are novices, and guidance can be faded as their competence grows (Kirschner et al., 2006). Therefore, PBL implementation should begin with guided inquiry and gradually move toward greater independence.

A third challenge is group work quality. Group discussion can promote HOTS, but it can also become superficial or unequal. Some students may dominate discussion, while others remain silent. Some groups may divide tasks mechanically without meaningful exchange. To avoid this problem, teachers need to design roles, discussion prompts, and accountability mechanisms that require each student to contribute to reasoning and reflection. The facilitator's role in collaborative knowledge building is especially important because productive questioning can help groups articulate assumptions, evaluate evidence, and construct shared explanations (Hmelo-Silver & Barrows, 2008).

A fourth challenge is assessment alignment. If a course claims to value HOTS but assesses only factual recall, students will rationally focus on memorization. PBL requires assessment methods that recognize process, reasoning, collaboration, evidence use, and reflection. The revised taxonomy provides one basis for aligning assessment with analysis, evaluation, and creation, while quality-learning theory emphasizes the alignment of learning objectives, activities, and assessments (Anderson & Krathwohl, 2001; Biggs et al., 2022).

However, many institutional assessment systems still favor written tests and standardized answers. Teachers may need to combine traditional assessment with rubrics, portfolios, presentations, peer evaluation, and reflective writing.

A fifth challenge is classroom scale and time. PBL often requires more time than lecture because students need opportunities to explore, discuss, revise, and present. Large classes make it difficult for teachers to monitor every group closely. These constraints suggest that PBL does not need to replace all conventional teaching. A more realistic approach is to use partial or modular PBL, in which selected topics are redesigned around problems while other content is supported through concise lectures, readings, or micro-learning material. This blended approach is consistent with active-learning research, which does not require abandoning all direct instruction but encourages meaningful student engagement during selected learning episodes (Prince, 2004; Freeman et al., 2014).

3.5 A Pedagogical Framework for Implementing PBL to Develop HOTS

Based on the conceptual analysis above, this article proposes a five-part framework for implementing PBL in Chinese higher education: authentic problem design, progressive scaffolding, structured collaboration, teacher facilitation, and multidimensional assessment. These components should be treated as mutually reinforcing rather than

separate steps. They are derived from PBL definitions and models that emphasize authentic problems, facilitation, self-directed inquiry, collaboration, and reflection (Barrows, 1996; Savery, 2006; Hung, 2006).

3.5.1 Authentic Problem Design

Problem design is the starting point of PBL. A useful PBL problem should be connected to course objectives, relevant to students' future learning or professional lives, and sufficiently open to allow multiple interpretations. It should also be manageable within the time and resources available. If a problem is too simple, students may only retrieve information. If it is too difficult, they may become lost. The teacher's task is to design problems that create cognitive challenge without producing unnecessary confusion. Problem-design research emphasizes that effective problems should support content learning, contextual meaning, knowledge connection, reasoning, research, and reflection (Hung, 2006; Jonassen, 2003).

In practice, teachers can begin with a real or realistic case and then formulate guiding questions. For example, in a language education course, students might analyze why learners with similar vocabulary knowledge perform differently in communicative tasks. In a science education course, they might design a low-cost experiment for a local school. In a vocational course, they might solve a workplace-related problem. The key is that students must need analysis, evidence, and judgment to reach a defensible solution.

3.5.2 Progressive Learning Scaffolds

In PBL, teachers remain central, but their role changes. They guide inquiry by asking questions rather than simply supplying answers. Productive facilitation questions include: What evidence supports this interpretation? What assumptions are you making? Are there alternative explanations? What are the limitations of this solution? How would your answer change if the context changed? These questions help students move from opinion to reasoning. This facilitative role is consistent with classic and contemporary definitions of PBL, in which teachers support thinking without replacing student inquiry (Barrows, 1996; Savery, 2006).

Scaffolding is essential when students are unfamiliar with PBL. At the beginning, teachers may provide worksheets for problem analysis, source evaluation checklists, examples of research questions, and templates for group reporting. These tools do not reduce students' thinking; they make thinking visible and manageable. The debate on guidance suggests that PBL should not be interpreted as minimally guided discovery, especially for novice learners (Kirschner et al., 2006). As students become more confident, scaffolds can be gradually removed or transformed into self-check questions.

A progressive approach is particularly suitable for Chinese classrooms. Instead of moving immediately from lecture to fully open inquiry, teachers can introduce PBL in stages. The first stage may involve guided problem analysis. The second stage may involve small-group inquiry with teacher-provided resources. The third stage may allow students to select sources and develop independent solutions. This progression respects students' previous learning habits while still moving them toward autonomy. It also responds to implementation tensions identified in PBL research, including learner readiness, facilitation demands, and institutional constraints (Hung et al., 2003; Boud & Feletti, 2013).

3.5.3 Structured Collaboration

Collaboration should be designed rather than assumed. Teachers can assign rotating roles such as discussion leader, evidence manager, questioner, recorder, and presenter. These roles ensure that group work includes both task completion and reasoning. Students should also be required to produce individual reflections so that personal accountability is maintained within group learning. Structured roles and facilitator questioning are important because collaborative knowledge building requires students to make reasoning visible, negotiate meaning, and revise explanations together (Hmelo-Silver &

Barrows, 2008).

Structured collaboration can also improve communication skills. When students present reasoning to peers, respond to disagreement, and revise ideas, they practice academic communication in a meaningful context. Teachers can strengthen this process by asking groups to document how they changed their initial assumptions and why they selected their final solution. This design connects with broader PBL arguments that problems can become opportunities for communication, teamwork, and situated problem solving (Barrows & Kelson, 1995; Torp & Sage, 1998).

3.5.4 Teacher Facilitation

Teacher facilitation also involves emotional and organizational support. Students who are new to PBL may experience uncertainty. Teachers can normalize this uncertainty by explaining that confusion is part of inquiry and by giving students clear milestones. Timely feedback is especially important because it prevents groups from moving too far in an unproductive direction while still preserving student autonomy. PBL outcome reviews and implementation studies repeatedly show that facilitation quality is one factor that shapes whether students experience productive inquiry or frustration (Albanese & Mitchell, 1993; Hmelo-Silver, 2004; Savery, 2006).

3.5.5 Multidimensional Assessment

Assessment should reflect the goals of HOTS. If the goal is to develop critical thinking, creativity, problem solving, communication, and collaboration, then assessment should capture these abilities. A multidimensional assessment system may include a final product, group presentation, individual reflection, peer evaluation, and teacher assessment of reasoning quality. Rubrics should make criteria explicit, such as problem definition, evidence use, originality, feasibility, communication clarity, and reflective depth. This approach aligns with the revised taxonomy and constructive alignment because assessment tasks should require the same types of thinking that the course claims to develop (Anderson & Krathwohl, 2001; Biggs et al., 2022).

Multidimensional assessment does not mean abandoning examinations. In many Chinese universities, examinations remain institutionally required. However, teachers can combine examinations with process-based tasks. This combination allows students to maintain necessary content learning while also developing higher-order abilities. The important point is that students should see a clear connection between PBL activities and course evaluation. In this respect, PBL assessment should balance content knowledge, problem-solving processes, self-directed learning, collaboration, and reflection (Schmidt, 1983; Norman & Schmidt, 1992; Savery & Duffy, 1995).

Table 2. Pedagogical Framework for PBL Implementation in Chinese Higher Education

Framework component	Core purpose	Classroom strategy	Expected HOTS contribution
Authentic problem design	Create a meaningful need for inquiry.	Use realistic cases, open-ended questions, and curriculum-aligned tasks.	Activates analysis, judgment, and problem identification.
Progressive scaffolding	Support students' transition to autonomy.	Use inquiry worksheets, source checklists, and staged problem tasks.	Develops self-directed learning and metacognitive control.
Structured collaboration	Make group learning accountable and dialogic.	Assign roles, require discussion records, and include peer evaluation.	Improves communication, collaboration, and reasoning.

Teacher facilitation	Guide inquiry without replacing student thinking.	Ask evidence-based, reflective, and comparative questions.	Strengthens critical thinking and evaluation.
Multidimensional assessment	Align evaluation with HOTS goals.	Use rubrics, reflection, presentations, products, and examinations.	Encourages transfer, creativity, and reflective improvement.

3.6 Implications for Teaching and Future Research

The framework proposed in this article has several implications for teaching. First, teachers should view PBL as a gradual reform rather than an all-or-nothing method. In courses where lecture remains necessary, selected modules can still be redesigned around problems. Second, teachers should treat students' initial difficulty with PBL as a pedagogical issue rather than as evidence that students are unsuitable for student-centered learning. With scaffolding and repeated practice, students can develop the learning habits required for inquiry. Third, assessment reform is essential. Without assessment alignment, students may not take PBL activities seriously, and teachers may find it difficult to justify the time invested in PBL. These implications are consistent with active-learning evidence and with research showing that PBL outcomes depend on implementation quality (Prince, 2004; Freeman et al., 2014; Strobel & van Barneveld, 2009).

The article also has implications for teacher development. Teachers need support in problem design, facilitation, group management, and rubric construction. Professional development should therefore move beyond general advocacy of student-centered learning and provide concrete examples of PBL tasks in different disciplines. Peer observation and teaching communities may be useful because teachers can share problem scenarios, discuss classroom difficulties, and revise materials collaboratively. Such support is important because PBL is a complex pedagogical system rather than a single technique (Boud & Feletti, 2013; Hung et al., 2003).

Future research should move from conceptual development to empirical testing. A quasi-experimental design could compare students who experience PBL with those who experience conventional instruction, using pre-test and post-test measures of HOTS. Mixed-method research could also be useful because quantitative results can show whether HOTS scores change, while interviews, classroom observation, and reflective journals can explain how students experience the learning process. Future studies should also consider that previous reviews have reported both positive outcomes and variations across PBL implementations (Albanese & Mitchell, 1993; Vernon & Blake, 1993; Dochy et al., 2003; Strobel & van Barneveld, 2009). In addition, future studies should examine whether different dimensions of HOTS respond differently to PBL. For example, problem-solving and collaboration may improve more quickly than creativity or critical thinking, depending on task design and assessment.

Researchers should also pay attention to context. PBL may operate differently across disciplines, class sizes, institutional types, and student populations. Therefore, future studies should avoid treating Chinese higher education as a uniform context. More fine-grained analysis can help identify when PBL is most effective, what support students need, and how teachers can adapt PBL to local conditions. Context-sensitive research is especially important because both Chinese pedagogical adaptation and large-scale HOTS reform depend on the interaction between policy, classroom culture, teacher capacity, and assessment practices (Li et al., 2012; Sahlberg, 2006; Zohar, 2013).

4. CONCLUSION

This article developed a conceptual review and pedagogical framework for using PBL to support

HOTS in Chinese higher education. The analysis suggests that PBL and HOTS are theoretically connected through authenticity, inquiry, dialogue, and reflection. PBL can create learning conditions in which students analyze complex problems, evaluate evidence, communicate with peers, develop solutions, and reflect on their thinking. These processes correspond closely to the major dimensions of HOTS.

At the same time, PBL should not be treated as a simple technique that automatically improves learning. Its value depends on careful design and contextual adaptation. In Chinese higher education, teacher-centered traditions, students' learning habits, assessment systems, large classes, and time constraints may affect implementation. Therefore, effective PBL requires authentic problem design, progressive scaffolding, structured collaboration, teacher facilitation, and multidimensional assessment.

The contribution of this article is practical and conceptual. Practically, it offers a framework that teachers can use when redesigning college courses for HOTS development. Conceptually, it clarifies why PBL is relevant to higher-order thinking and why local adaptation matters. As universities continue to emphasize innovation, independent learning, and professional readiness, PBL provides a promising pathway for shifting classroom practice from knowledge transmission to ability formation. The next step is to test and refine this framework through empirical research in Chinese college classrooms.

RECOMMENDATIONS

This article recommends that higher education teachers introduce PBL gradually rather than as a sudden replacement for all lecture-based instruction. Teachers may begin with selected course modules, design authentic but manageable problems, and provide students with explicit scaffolds for inquiry, source evaluation, collaboration, and reflection. Institutions should also support teachers through training in problem design, facilitation, group management, and multidimensional assessment. Future researchers are encouraged to test the proposed framework through quasi-experimental or mixed-method studies in Chinese college classrooms.

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AUTHOR'S CONTRIBUTIONS

All authors discussed the conceptual framework, reviewed relevant literature, and contributed to the writing and revision of the manuscript.

CONFLICT OF INTEREST

The authors declare that they have no competing interests.

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