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Implementing The Problem-Based Learning Model In The Vuca Era To Enhance Student Competencies

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ABSTRACT

The rapid, unpredictable shifts of the VUCA (Volatility, Uncertainty, Complexity, and Ambiguity) era necessitate a profound paradigm shift in educational frameworks away from rote memorization toward adaptive competence. Purpose of the Study: This study explores how the implementation of the Problem-Based Learning (PBL) model can effectively prepare and equip students with the critical cognitive and moral competencies required to thrive in the VUCA era. Methods: Using a qualitative library research method, a systematic analysis of authoritative books, literature, and peer-reviewed journals was conducted to synthesize the strategic intersection between PBL implementation, cognitive scaffolding, and national character education. Results: The findings reveal that PBL acts as a crucial procedural process where students construct contextual knowledge by resolving authentic, ill-structured problems. Furthermore, in the uncertainty of the VUCA landscape, the strategic application of dynamic scaffolding (combining adding and fading) enhances self-directed learning. Integrating localized character development, such as Pancasila values and national ideology, into the PBL framework is essential for filtering information overload and countering moral degradation, thereby producing graduates who are both intellectually capable and ethically grounded.

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INTRODUCTION

Changes occurring in the present and those that cannot be predicted in the future are referred to as the VUCA era. VUCA stands for Volatility, Uncertainty, Complexity, and Ambiguity. In facing future changes driven by the rapid development of the times, humans must become more adaptive. In order to avoid being unprepared and to address these challenges, education is specifically designed to equip individuals with the ability to build networks and solve problems.The world is currently experiencing an unprecedented pace of transformation.

Technological advancements, geopolitical shifts, climate change, and global health crises have collectively created an environment where traditional approaches to education are increasingly insufficient. The conventional model of education, which emphasizes rote memorization and standardized testing, is no longer adequate in preparing students for the challenges they will face in their professional and personal lives. To bridge this gap, modern educational systems must transition toward more adaptive framework designs, such as the application of differentiated learning models that align with student diversity and specific skills profiles (Gunawan et al., 2024). There is a growing recognition among educators, policymakers, and researchers that students need to develop higher-order thinking skills, adaptability, and the capacity for lifelong learning.In this context, Problem-Based Learning (PBL) emerges as a particularly relevant and effective pedagogical approach. Unlike traditional instructional methods, PBL places students at the center of the learning process, challenging them to engage with real-world problems, collaborate with peers, and construct their own understanding through active inquiry. This approach not only develops subject-matter expertise but also cultivates the critical thinking, communication, and problem-solving skills that are essential for success in the VUCA era.Several graduate competencies are stipulated in the Regulation of the Minister of National Education No. 23 of 2006 (Kementerian Pendidikan Nasional Republik Indonesia, 2006) regarding critical thinking abilities, stating that students must:Absorb information critically, logically, and creatively;Demonstrate innovative and logical thinking;Recognize their own potential and maintain a high sense of curiosity;Be capable of solving problems; Understand the social environment and natural phenomena around them; and Continuously develop their existing potential.Institutions have raised concerns that graduates struggle with teamwork and problem-solving due to their low quality (Wahyuni, n.d.). The mismatch between what education systems produce and what the contemporary world demands has become an increasingly pressing concern. Employers consistently report that new graduates lack the practical skills, adaptability, and collaborative competencies needed in modern workplaces. This disconnect highlights the urgent need for pedagogical innovation—a shift from passive knowledge transmission to active, problem-centered learning experiences that mirror the complexity of real-world challenges. To address these complex challenges in planning and organizing curriculum development, educational managers can combine modern problem-solving frameworks with localized wisdom strategies (Elfira et al., 2023).According to Wena, (2011), PBL is a challenging learning approach that presents problems through a learning model that directly confronts students with real issues. Agus & Suprijono, (2013) state that a learning model is defined as the process of discovering a problem through information, transformation, and evaluation. A learning strategy aimed at understanding concepts and solving problems by considering current conditions Komalasari & Kokom, (2013), where students acquire new knowledge and are encouraged to be more active (Hollmann et al., 2011), refers to a learning approach in which students construct their own knowledge by working through problems. In the VUCA era, students are required to be prepared, adaptive, competent, and highly intellectual. Education plays a vital role in preparing students to face the future, in line with Ki Hajar Dewantara's theory that education is meant to liberate. In this context, the VUCA era poses a significant challenge to education, where liberation is interpreted as the ability to face and overcome challenges. Ki Hajar Dewantara's philosophical foundation remains deeply relevant today; true education liberates individuals not merely from ignorance, but from the limitations of rigid thinking patterns that prevent them from responding creatively and courageously to new challenges (Saleh & Elfira, 2025).The integration of PBL into educational systems represents more than a methodological shift; it reflects a fundamental reconceptualization of what it means to learn and to teach. When students are presented with authentic, ill-structured problems the kind that do not have clear-cut answers they are compelled to draw upon diverse knowledge domains, engage in collaborative dialogue, and exercise

judgment in conditions of uncertainty. These are precisely the competencies demanded by the VUCA world.Furthermore, the role of character education in this framework cannot be understated. In an era characterized by information overload, the proliferation of misinformation, and the erosion of shared values, students must be equipped not only with cognitive tools but also with moral compasses. The cultivation of values such as integrity, empathy, resilience, and civic responsibility is integral to producing graduates who will contribute positively to society and resist the destructive forces of extremism, cynicism, and moral relativism. This study therefore seeks to examine the implementation of Problem-Based Learning in the context of the VUCA era, exploring how this pedagogical approach can be leveraged to develop students who are intellectually capable, morally grounded, and adaptively resilient in the face of an unpredictable future.

METHOD

This study is a library or literature research related to the issues of problem-based learning. The problems are explored through the use of patterns, hypotheses, and theories. The research utilizes books and journals as primary sources in accordance with the topics of the VUCA era and Problem-Based Learning (PBL). Literature study was employed as the data collection technique. Data were collected based on research themes relevant to the study. Scientific journals and books used in this research were selected in accordance with the PBL model. PBL itself serves as a framework for deeply examining and exploring a problem in a comprehensive and systematic manner. The literature review process involved a systematic search of academic databases including Google Scholar, ERIC, and Scopus, using keywords such as "Problem-Based Learning," "VUCA era," "critical thinking," "student competence," and "character education." Sources were selected based on their relevance to the research questions, their methodological rigor, and their publication in peer-reviewed journals or reputable academic presses. Priority was given to sources published within the last decade, although seminal works from earlier periods were also included where appropriate.The analysis of the collected literature followed a thematic approach, grouping findings according to the major themes identified in the research questions: the nature and implementation of PBL, the characteristics and challenges of the VUCA era, and the intersection of PBL and VUCA preparedness. This thematic organization allowed for a coherent synthesis of diverse perspectives and findings, enabling the identification of patterns, convergences, and gaps in the existing literature.Data triangulation was achieved through the cross-referencing of findings from multiple sources, ensuring that conclusions drawn were supported by a body of evidence rather than isolated studies. The researcher maintained a reflexive stance throughout the process, acknowledging the inherent subjectivity involved in interpreting and synthesizing qualitative and theoretical literature.

RESULTS AND DISCUSSION

Analysis of Problem-Based Learning

The research by Hmelo & Silver, (2015) provides an in-depth examination of how facilitators develop skills such as causal reasoning, questioning, and inquiry in students. The study introduces important theoretical foundations that help readers avoid oversimplifying PBL and establishes a systematic way of viewing PBL experiences. The research evaluates the impact of Problem-Based Learning by focusing on PBL from large-scale data, thereby linking statistical analysis and empirical validation to existing theories. In particular, this section explores how PBL has been adopted across disciplines such as medical education, teacher education, and engineering. The study also highlights students who experience difficulties with PBL and discusses ways to approach learning holistically, including aspects of motivation and engagement.

Problem-Based Learning was originally developed at McMaster University in the 1960s as a response to the perceived inadequacies of traditional medical education. The founding educators recognized that medical students needed more than factual knowledge—they needed the ability to reason clinically, to work collaboratively with colleagues, and to engage in continuous self-directed learning. The problems presented in PBL are deliberately ill-structured, meaning they do not come with a predefined solution path. This characteristic is essential, as it mirrors the nature of real professional challenges and forces students to engage in genuine inquiry rather than simply applying memorized formulas.

Over the subsequent decades, PBL spread beyond medical education to encompass fields as diverse as law, engineering, architecture, business, and the humanities. This disciplinary diffusion attests to the versatility and robustness of PBL as a pedagogical framework. Each disciplinary context brings its own set of authentic problems, professional norms, and epistemic practices, requiring PBL to be adapted and contextualized rather than applied as a one-size-fits-all solution.

The findings of Kim et al., (2018) reveal that the most notable result concerns the effect of combining adding and fading in scaffolding customization. Adding scaffolding is often overlooked in the context of PBL. However, in PBL, which requires various student abilities such as information-seeking strategies, problem-solving skills, creative thinking, and collaborative learning skills, adding scaffolding should be considered alongside fading as an effective strategy to promote strong learning outcomes. Furthermore, when scaffolding customization is carried out by students themselves, the effect may be most beneficial, as self-selected scaffolding can enhance students' self-directed learning and motivation.

Scaffolding, in the context of PBL, refers to the temporary support structures provided by instructors, peers, or technology to help students engage with problems that exceed their current capabilities. The concept originates from Vygotsky's zone of proximal development the gap between what learners can accomplish independently and what they can achieve with appropriate guidance. Effective scaffolding in PBL is dynamic and responsive, expanding or contracting in response to students' evolving needs and competencies.

The distinction between adding scaffolding and fading scaffolding is particularly significant. Adding scaffolding involves introducing new supportive resources as students encounter unfamiliar or particularly challenging aspects of a problem. Fading scaffolding, conversely, involves gradually withdrawing support as students develop greater independence and confidence. The research suggests that an optimal PBL environment strategically employs both approaches, calibrating support to the specific demands of each learning moment.

According to the findings, question prompting is the most prominent computer-based scaffolding strategy; however, its effect is not as strong as many scholars believe. The primary purpose of scaffolding is to help students increase engagement in learning and successfully complete assigned tasks that are currently beyond their abilities. Nevertheless, if question prompting in PBL is provided in a complicated and difficult manner, it may become a barrier to learning rather than a support. Therefore, the study suggests that simpler and more directive supports, such as hints and expert modeling, are more suitable for PBL.

This finding carries important implications for the design of technology-enhanced PBL environments. As educational institutions increasingly integrate digital tools into their instructional practices, the synergy between professional digital competence, technology leadership, and a collaborative digital culture becomes paramount for achieving educational excellence in this unpredictable landscape (Rasdiana et al., 2024). However, the evidence suggests that cognitive load must be carefully managed; when the scaffolding itself becomes cognitively demanding, it distracts students from the primary challenge of engaging with the problem. The

principle of simplicity and directness in scaffolding design therefore emerges as a crucial design consideration.

The results obtained from the literature study indicate that students who struggle with PBL learn by discussing approaches holistically, including aspects of motivation and engagement. PBL encompasses various student abilities such as information-seeking strategies, problem-solving skills, creative thinking, and collaborative learning skills, in which adding scaffolding should be considered alongside fading as an effective strategy to promote learning outcomes. PBL is a student-centered instructional approach that aims to develop both individual and collaborative problem-solving skills (Savery, 2019).

The collaborative dimension of PBL deserves particular emphasis. Learning in small groups is not merely an organizational convenience; it is a fundamental feature of PBL that serves multiple pedagogical purposes. Group work exposes students to diverse perspectives and problem-solving approaches, challenging them to articulate and defend their reasoning, negotiate meaning with peers, and develop the interpersonal communication skills that are indispensable in professional settings. The social construction of knowledge—the process by which understanding emerges through dialogue and collaborative inquiry—is thus central to the PBL experience.

In line with this, problem-solving is considered a process for overcoming difficulties encountered in achieving desired goals (Samarmo & Ibrahim, 2000). Branca, (1980) states that problem-solving can be interpreted through three general interpretations: problem-solving as a goal, problem-solving as a process, and problem-solving as a basic skill. Problem-Based Learning was developed by educators at McMaster University as an instructional approach for medical education in the 1960s, in response to the challenges they faced with traditional didactic approaches used to prepare medical students for clinical practice.

Problem-solving as a goal concerns the fundamental reason why learning is designed to prepare students for meaningful engagement with real-world challenges. In this interpretation, the ability to solve problems is not merely a desirable educational outcome it is the primary justification for the entire educational enterprise. Problem-solving as a process refers to an activity that prioritizes the importance of procedures and tactical steps taken by students in resolving problems, ultimately enabling them to find answers rather than focusing solely on the answers themselves. Problem-solving as a basic skill emphasizes the foundational, transferable nature of problem-solving competency its applicability across disciplines, contexts, and career trajectories.

The Problem-Based Learning model therefore represents a synthesis of all three interpretations. It positions problem-solving simultaneously as the goal of education, the process through which learning occurs, and the fundamental skill being cultivated. This integrative conception gives PBL its distinctive coherence and power as a pedagogical framework.

The VUCA Era

The world today has become volatile, uncertain, complex, and ambiguous (VUCA). In such a world, supply chains are not only embedded in VUCA environments but are also increasingly exhibiting VUCA characteristics. The widely recognized description of VUCA characteristics is outlined as follows: Volatility refers to events faced by supply chains that are unexpected or unstable; however, information about such events is available and their impact can generally be predicted. Uncertainty means that the causes and effects of an event faced by the supply chain are known; however, other information about the event is unavailable. Complexity indicates that both the environment and the supply chain itself have many interconnected parts and variables, making it extremely difficult to link the causes and effects of an event. Ambiguity refers to events faced by the supply chain that are unpredictable, with cause-and-effect relationships that are entirely unclear (Gao et al., 2021).

VUCA represents a challenge that must be faced by both global businesses and governments. VUCA, which stands for Volatility, Uncertainty, Complexity, and Ambiguity, illustrates the current situation in the global business environment. The term was originally coined by the American military to describe the geopolitical situation at the time, but due to its evolving meaning, VUCA has since been adopted by the global business and public sectors (Firmansyah & Anang, 2019).

The military origins of VUCA are instructive. The term was first used by the United States Army War College in the early 1990s to describe the post-Cold War world—a world that, having shed the relative predictability of bipolar superpower competition, had become significantly more complex, fluid, and unpredictable. The subsequent adoption of VUCA by the business and educational communities reflects the recognition that the challenges facing organizations and individuals in the contemporary world share fundamental characteristics with the challenges of military leadership in conditions of extreme uncertainty.

Volatility, as a VUCA characteristic, refers not simply to change but to the rate and unpredictability of change. In volatile environments, conditions can shift dramatically and rapidly, rendering plans and strategies obsolete almost as soon as they are formulated. This characteristic is particularly evident in the technological domain, where the pace of innovation means that skills and knowledge acquired today may be outdated within a few years. For educators, this underscores the importance of teaching students how to learn and adapt, rather than focusing exclusively on the transmission of specific content knowledge.

Uncertainty, the second VUCA characteristic, refers to the lack of predictability regarding the causes and effects of events. In uncertain environments, even well-informed, experienced decision-makers cannot confidently predict the outcomes of their choices. This characteristic has profound implications for education: students must develop the cognitive flexibility and emotional resilience to act decisively in conditions where certainty is unavailable, while simultaneously maintaining intellectual humility about the limits of their knowledge.

Complexity, the third characteristic, refers to the proliferation of interconnected factors that influence outcomes. In complex environments, simple cause-and-effect relationships give way to intricate webs of interdependence, where actions in one domain produce unexpected ripple effects across others. The global COVID-19 pandemic provided a vivid illustration of complexity a health crisis that simultaneously triggered economic disruptions, social transformations, political upheavals, and educational challenges on a global scale.

Ambiguity, the fourth VUCA characteristic, refers to the haziness of reality and the potential for misinterpretation. In ambiguous environments, available information is incomplete, contradictory, or insufficiently clear to support definitive conclusions. This characteristic is particularly challenging for education systems that traditionally reward students for producing definitive, correct answers; the VUCA era demands comfort with ambiguity and the ability to make thoughtful decisions in conditions of incomplete information.

Bob Johansen reminds us that the turbulence of VUCA should not be viewed solely from a negative perspective. To remain optimistic, we need to transform the negative meaning of VUCA into something positive through VUCA Prime: Vision, Understanding, Clarity, and Agility (Robert Johansen, 2012). This reframing is particularly relevant for educators, who bear the responsibility of preparing students not to be overwhelmed by VUCA conditions but to respond to them with creativity, purpose, and resilience.

Vision, in the VUCA Prime framework, serves as the antidote to volatility—a clear and compelling sense of purpose that provides direction and motivation even when external conditions are turbulent and unpredictable. Understanding counteracts uncertainty by deepening knowledge of the complex systems and relationships that shape outcomes, enabling

more informed and confident decision-making. Clarity addresses complexity by simplifying and communicating essential priorities in ways that enable coordinated action. Agility responds to ambiguity by cultivating the flexibility and speed of response needed to adapt effectively to rapidly changing circumstances.

The implications of VUCA Prime for education are significant. Rather than simply preparing students to survive in a VUCA world, the educational mission should be to cultivate individuals who can lead and shape that world—individuals who bring vision, understanding, clarity, and agility to the challenges they face.

Implementation of Problem-Based Learning in the VUCA Era

A love of the homeland, the cultivation of Pancasila values, and nationalism certainly help students in filtering information and making decisions, so that character education can serve as a foundation for dealing with negative news, terrorism, and hoaxes that threaten character degradation. PBL trains students to use technology positively and to critically process information in an era of uncertainty while maintaining their national ideology.

The implementation of PBL in the VUCA era requires a fundamental rethinking of both curriculum design and pedagogical practice. Traditional curricula, organized around discrete subject areas and delivered through sequential, instructor-centered lessons, are ill-suited to developing the integrative, adaptive competencies demanded by VUCA conditions. PBL, by contrast, naturally integrates knowledge from multiple domains in the service of addressing complex, real-world problems, mirroring the interdisciplinary nature of contemporary challenges.

Effective PBL in the VUCA era begins with the selection of authentic, meaningful problems that genuinely reflect the complexity and ambiguity of real-world challenges. These problems should be sufficiently ill-structured to require genuine inquiry and collaborative problem-solving, yet sufficiently bounded to be manageable within the constraints of an educational setting. The best VUCA-era PBL problems are those that connect to students' lived experiences and future professional contexts, creating intrinsic motivation and a sense of personal relevance.

The role of the instructor in VUCA-era PBL shifts dramatically from that of a knowledge transmitter to a learning facilitator. The facilitator's primary responsibility is not to provide answers but to guide students' inquiry processes—asking probing questions, helping students identify gaps in their knowledge, encouraging productive collaboration, and modeling the dispositions of an expert problem-solver. This facilitative role requires a sophisticated repertoire of skills, including the ability to tolerate ambiguity, to recognize and respond to diverse learning needs, and to create a psychologically safe environment in which students feel comfortable taking intellectual risks.

The integration of digital technologies into VUCA-era PBL creates both opportunities and challenges. On the one hand, digital tools expand students' access to information, enable new forms of collaboration, and create authentic contexts for problem-solving. On the one hand, the information overload characteristic of the digital age can overwhelm students who lack the critical literacy skills needed to evaluate and synthesize diverse sources. The cultivation of digital literacy—the ability to navigate, evaluate, and ethically use digital information—is therefore an essential component of VUCA-era PBL.

Character education, as noted earlier, plays a crucial role in preparing students for the VUCA era. The cultivation of values such as intellectual integrity, empathy, perseverance, and civic responsibility is not separate from academic learning but deeply integrated with it. Students who possess strong moral compasses are better equipped to navigate the ethical dilemmas and conflicting pressures that characterize contemporary professional environments. They are more likely to use their problem-solving skills in service of the common good rather than narrow self-

interest, and are more resistant to the manipulation and deception that flourish in conditions of information uncertainty.

The cultivation of Pancasila values within the PBL framework provides Indonesian students with a distinctive moral and civic foundation for engaging with VUCA challenges. The five principles of Pancasila offer a coherent value system that can guide decision-making in conditions of moral ambiguity and social complexity. By grounding PBL in Pancasila values, Indonesian educators can help students develop the character strength needed to resist the corrosive effects of extremism, corruption, and social division.

Furthermore, the development of information literacy within PBL is particularly critical in an era characterized by the proliferation of misinformation and disinformation. Students must learn not only to access and retrieve information but to critically evaluate its credibility, identify potential biases and agendas, and synthesize diverse perspectives into coherent and well-supported conclusions. These skills are foundational for informed citizenship and responsible professional practice in the VUCA era.

Analysis of the Implementation of Problem-Based Learning in the VUCA Era

Based on the results of the literature study, it was found that the world today has become volatile, uncertain, complex, and ambiguous (VUCA), and in such a world, supply chains not only exist within VUCA environments but are also increasingly displaying VUCA characteristics. VUCA is a challenge that must be faced globally by both businesses and governments. The condition of uncertainty brought about by change is referred to as VUCA, standing for Volatility, Uncertainty, Complexity, and Ambiguity (Ariwbowo, Handy, & Alexander, 2018). VUCA is described as follows:

Volatility refers to unpredictable changes that can occur at any time, influencing the rate of change by identifying the causes of instability. In educational terms, volatility demands curriculum flexibility and the development of students' adaptive learning capacities.

Uncertainty refers to unexpected variables with impenetrable boundaries, where numerous variables influence outcomes. Emerging uncertainty can be managed through critical thinking. Education must therefore prioritize the development of students' capacities for evidence-based reasoning and confident decision-making under uncertainty.

Complexity refers to the increasing complexity of components in light of ongoing developments. Educational responses to complexity include interdisciplinary learning, systems thinking, and the cultivation of students' capacities for synthesizing diverse perspectives.

Ambiguity refers to a state of uncertainty in which the outcomes achieved are influenced by the information obtained, without reference to a single goal but rather to current available information. Education must help students develop comfort with ambiguity and the ability to act thoughtfully in conditions of incomplete information.

The next generation must receive character education in order to filter existing information and uphold national ideology. In the VUCA era, PBL educates students to distinguish good information and to be critical in absorbing information. This critical capacity is not merely intellectual but also moral—students must develop the ethical sensitivity to recognize when information is being used to manipulate, deceive, or harm, and the courage to resist such manipulation even when social pressures favor conformity.

The implementation of PBL in response to VUCA challenges also requires attention to the affective dimensions of learning. Students who are anxious, demoralized, or disengaged will not develop the resilience and adaptability needed for VUCA competency, regardless of the sophistication of the instructional approach. Effective VUCA-era PBL must therefore attend to students' emotional well-being, creating learning environments characterized by psychological

safety, authentic caring relationships, and a genuine belief in every student's capacity for growth and excellence.

The assessment of learning in VUCA-era PBL presents particular challenges and opportunities. Traditional assessment approaches, which emphasize the recall of factual information under controlled conditions, are poorly aligned with the competencies developed through PBL. More appropriate assessment strategies include performance-based tasks, portfolios, collaborative projects, and reflective journals—approaches that capture the complexity and depth of student learning while also providing authentic feedback for continued growth:

Summary of Research Findings

Table 1. Summary of Research Findings

No	Title	Author	Year	Research Findings
1	Essential Readings in Problem-Based Learning: Exploring and Extending the Legacy of Howard S. Barrows	Walker, A., Leary, H., Hmelo-Silver, C., & Ertmer, P.	2015	An in-depth perspective on how facilitators develop skills such as causal reasoning, questioning, and inquiry in students. Along with introducing important theoretical foundations, this section helps readers avoid oversimplifying PBL and establishes a systematic way of viewing PBL experiences. The study evaluates the impact of Problem-Based Learning by focusing on large-scale PBL data, linking statistical analysis and empirical validation to existing theories. In particular, it explores how PBL has been adopted across disciplines such as medical education, teacher education, and engineering.
2	Effectiveness of Computer-Based Scaffolding in the Context of Problem-Based Learning for STEM Education: A Bayesian Meta-Analysis	Nam Ju Kim, Brian R. Belland, & Andrew E. Walker	2017	The most notable finding concerns the effect of combining adding and fading in scaffolding customization. Adding scaffolding is often overlooked in PBL contexts. However, since PBL requires various student abilities such as information-seeking strategies, problem-solving skills, creative thinking, and collaborative learning, adding scaffolding should be considered alongside fading as an effective strategy to promote strong learning outcomes. When scaffolding customization is carried out by students themselves, the effect may be most beneficial, as self-selected scaffolding can enhance self-directed learning and student motivation. Question prompting is the most prominent computer-based scaffolding strategy, but its effect is not as strong as many scholars believe. If question prompting is provided in a complicated manner, it may become a barrier rather than a support. Therefore, simpler and

				more directive supports such as hints and expert modeling are more suitable for PBL.
3	Managing Supply Chain Resilience in the VUCA Era	Ying Gao, Zhuo Feng, & Shuibo Zhang	2021	In the VUCA world, not all risks can be proactively prevented and mitigated. If unprepared risks materialize and cause disruptions, resilient supply chains must have the capacity for rapid recovery. Future research should explore the value of new technologies in supply chain recovery, such as how big data can help disrupted supply chain members quickly find available suppliers. While blockchain technology is recognized for facilitating information sharing and building trust, barriers to implementing it during supply chain recovery remain unknown. Building dynamic capabilities to match new technology adoption for rapid supply chain recovery is another research direction. A systematic view must be adopted in studying supply chain resilience, as it should not be built in fragmentation but considered holistically within a co-opetition environment. Multidisciplinary research and various methodologies are needed to effectively build supply chain resilience in the VUCA era.
4	Leaders Make the Future: Ten New Leadership Skills for an Uncertain World	Robert Johansen	2012	Bob Johansen reminds us that the turbulence of VUCA should not be viewed solely from a negative perspective. To remain optimistic, we need to transform the negative meaning of VUCA into something positive through VUCA Prime: Vision, Understanding, Clarity, and Agility.

CONCLUSION

Conclusions should be written briefly. Problem-Based Learning aims to prepare students for comprehensive competency and character development. Through structured problem-solving processes and dynamic scaffolding, educational institutions can foster environments that cultivate critical awareness and collaborative excellence. Furthermore, future students are also required to possess VUCA Prime qualities, namely Vision, Understanding, Clarity, and Agility, in order to be more flexible and adaptive in facing all forms of change. While this library research synthesizes critical literature on PBL and VUCA, it is limited by the absence of empirical fieldwork. Future researchers are encouraged to conduct empirical studies testing these pedagogical strategies in specific classroom settings, particularly concerning the impact of combined adding-fading scaffolding on students' problem-solving efficacy.

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AUTHOR CONTRIBUTIONS STATEMENT

EE conceptualized the study, performed the literature search, selected literature sources, conducted the thematic analysis, interpreted the findings, and drafted the manuscript as the sole researcher.

AI USAGE STATEMENT

This section is a statement from the author that the use of Artificial Intelligence (AI) tools in this work is strictly limited to supportive functions, and authors are only permitted to use AI for language editing, grammar checking, and improving clarity and readability. AI was not used to generate core ideas, conduct substantive analysis, interpret data, or draw scholarly conclusions. The author retains full responsibility for the originality, accuracy, and academic integrity of the content, and AI tools are not credited as authors or contributors, in accordance with ethical standards in academic publishing.

CONFLICT OF INTEREST

The author declares that there is no conflict of interest regarding the research, authorship, and publication of this article.

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