Integrating Competency-Based Education and Sustainable Development Goals in Early Childhood Classrooms: A Mixed-Methods Study at Anuban Sampasa Baantonmai Kindergarten School

Ketsaraphan Punsrigate
Curriculum and Instruction of Education, University of Phayao, Thailand
E-mail: phimmy.pt@gmail.com

Kittipong Ketsophon
Curriculum and Instruction of Education, University of Phayao, Thailand
E-mail: phimmy.pt@gmail.com

Sasiliya Monthienvichienchai
Curriculum and Instruction of Education, University of Phayao, Thailand
E-mail: phimmy.pt@gmail.com

Jakarapong Boontangeen
Science Education Program, Faculty of Science and Technology, University of Phayao, Thailand
E-mail: phimmy.pt@gmail.com

Pariyanee Asumpinpong
Curriculum and Instruction of Education, University of Phayao, Thailand
E-mail: phimmy.pt@gmail.com

Primkunlarak Chaipatwaratchaya*
Education Administration, University of Phayao, Thailand
*Corresponding author E-mail: phimmy.pt@gmail.com

Khunpharisorn Chaipatwaratchaya
Education Administration, University of Phayao, Thailand
E-mail: phimmy.pt@gmail.com

Gotchanipha Masim
Master of Education Program in Educational Administration, Chiang Mai University, Thailand
E-mail: phimmy.pt@gmail.com

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Abstract

The accelerating pace of globalization, climate change, and social complexity demands that early childhood education move beyond foundational skill acquisition toward the deliberate cultivation of competencies, values, and sustainability awareness. Although Thailand's Early Childhood Curriculum B.E. 2560 (2017) emphasizes holistic child development, limited empirical research has examined instructional models that systematically integrate Competency-Based Education (CBE) with the Sustainable Development Goals (SDGs) in authentic early childhood classroom practices. This mixed-methods study examined the appropriateness and preliminary effectiveness of an integrated instructional framework that embeds Competency-Based Education (CBE) within the Sustainable Development Goals (SDGs) for early childhood learners at a private trilingual kindergarten in Bangkok, Thailand. The study involved 56 kindergarten children (Years 2–3), 8 class teachers, and 2 administrators, and was conducted during the first semester of the 2025 academic year (July–August 2025). Data were collected through (1) activity documentation records identifying target competencies and linked SDGs, (2) pre–post behavioral observation checklists assessed by classroom teachers, and (3) teacher reflection questionnaires. Content validity of all instruments was confirmed by three expert reviewers (IOC range = 0.67–1.00). Expert evaluation of the integrated framework yielded a high suitability rating (M = 4.67, SD = 0.25, on a 5-point scale). Pre–post behavioral observations across two prototype activities — 'Grow with Our Hands, Grow with Our Hearts' (gardening) and 'Exploring

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Insects in the Garden' (nature inquiry) — revealed substantial increases in children's consistent-level performance in communication (25% → 60%), environmental responsibility (25% → 65%), and systems thinking (25% → 45%). Teacher reflection scores indicated strong endorsement (M = 4.43, SD = 0.17), with all participating teachers expressing their intention to continue implementing the approach. The findings provide preliminary empirical evidence that integrating CBE with the SDGs constitutes a developmentally appropriate instructional framework for early childhood education and extends the application of competency-based pedagogy by demonstrating how sustainability competencies can be operationalized through authentic, play-based learning experiences in the Thai context. The study contributes to the theoretical integration of competency-based learning and sustainability education in early childhood while offering an evidence-informed framework for curriculum development, teacher professional learning, and future research.
Keywords: Competency-based education; Sustainable development goals; Early childhood education; Integrated learning; Environmental responsibility; 21st-century competencies

Introduction

The early childhood years—from birth through approximately age eight—represent a critical period of developmental plasticity during which children's cognitive, social, emotional, and moral foundations are established (Berk, 2018; Piaget, 1952). Consequently, early childhood education is increasingly expected to prepare children not only with foundational literacy and numeracy skills but also with the competencies required to participate responsibly in rapidly changing societies. However, early childhood curricula in many educational systems continue to emphasize academic readiness, motor development, and self-care routines, while providing comparatively limited opportunities for children to develop higher-order competencies such as communication, critical thinking, collaboration, environmental responsibility, and global citizenship through authentic learning experiences (Office of the Education Council of Thailand, 2021).

This educational challenge has become increasingly significant following the adoption of the United Nations' 2030 Agenda for Sustainable Development. Among its seventeen Sustainable Development Goals (SDGs), SDG 4 emphasizes inclusive and equitable quality education, while Target 4.7 explicitly calls for all learners to acquire the knowledge, skills, values, and attitudes necessary to promote sustainable development (United Nations, 2015; UNESCO, 2017). Although these goals are often interpreted within primary and secondary education, growing evidence suggests that sustainability education should begin during early childhood, when children's values, attitudes, and lifelong learning habits are first established (Ärlemalm-Hagsér & Davis, 2014). In Thailand, recent educational reforms similarly advocate competency-oriented learning rather than content transmission alone. The National Education Plan (2017–2036), the Early Childhood Curriculum B.E. 2560 (2017), and competency-based curriculum reforms promoted by the Ministry of Education and the Office of the Education Council emphasize holistic child development, learner competencies, active learning, and responsible citizenship appropriate to the twenty-first century. Nevertheless, classroom implementation remains uneven. Early childhood learning activities continue to focus primarily on developmental domains and academic preparation, while practical instructional models that intentionally integrate competency-based learning with sustainability education remain limited, particularly in private kindergarten settings. Consequently, teachers often lack empirically validated frameworks for translating national policy aspirations into classroom practice. This need is particularly relevant for children of Generation Beta (McCrindle, 2020), who will grow up amid accelerating climate change, technological transformation, and increasing global interdependence. Preparing young children for these realities requires learning experiences that are concrete, experiential, and developmentally appropriate. Activities such as gardening, observing insects, recycling, and caring for natural environments enable children to construct early understandings of sustainability while simultaneously developing communication, collaboration, problem-solving, and environmental responsibility (UNESCO, 2017; Ärlemalm-Hagsér & Davis, 2014).

Competency-Based Education (CBE) provides a promising pedagogical framework for achieving these goals because it emphasizes the demonstration of integrated knowledge, skills, attitudes, and values in authentic contexts rather than the acquisition of isolated content knowledge (Gervais, 2016; OECD, 2018). However, existing CBE applications in early childhood education frequently prioritize observable academic competencies while giving comparatively less attention to sustainability-related competencies and ethical citizenship. Integrating the SDGs into CBE therefore offers an opportunity to extend competency-based pedagogy by embedding sustainability concepts within meaningful play-based learning experiences.

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Against this background, this study investigates an integrated CBE-SDG instructional framework implemented at Anuban Sampasa Baantonmai Kindergarten, a private trilingual early childhood school in Bangkok, Thailand. The school was selected because it had initiated the implementation of competency-based and sustainability-oriented learning activities that aligned with both Thailand's educational reform agenda and international sustainability goals. Through expert evaluation, classroom behavioral observation, and teacher reflection, this study provides empirical evidence regarding the feasibility, appropriateness, and preliminary effectiveness of integrating Competency-Based Education with the Sustainable Development Goals in authentic early childhood classrooms. The findings contribute to bridging the gap between international educational policy, Thailand's competency-based reform initiatives, and practical classroom implementation in early childhood education.

Objectives of Research

1. To examine the appropriateness of an integrated CBE–SDGs instructional framework for early childhood learners in a Thai private kindergarten context.

2. To evaluate the preliminary effectiveness of prototype CBE–SDGs learning activities in developing key competencies in kindergarten children, and to assess teacher readiness and perceptions of the framework.

Literature Review

1. Competency-Based Education: Principles and Application in Early Childhood

Competency-Based Education (CBE) is grounded in the premise that the goal of education is not the transmission of subject-matter content but the development of integrated capacities — combinations of knowledge, skills, and attitudes — that enable effective, responsible action in authentic situations (Gervais, 2016; Mulder, 2017). The OECD's (2018) Learning Framework 2030 articulates three categories of transformative competencies particularly relevant to CBE: the ability to create new value, to reconcile tensions and dilemmas, and to take responsibility for one's actions. In the early childhood context, CBE takes developmentally adapted forms. Piaget's (1952, 1973) theory of cognitive development places children aged three to seven in the pre-operational stage, during which abstract reasoning is limited but learning through direct, concrete, symbolic experience is highly effective. Vygotsky's (1978) sociocultural theory adds that competency development is fundamentally social: children develop their capabilities most effectively within scaffolded interactions with more capable peers or adults, operating within what he termed the Zone of Proximal Development (ZPD). Bloom's (1956) taxonomy of educational objectives, spanning from recall through creation across cognitive, affective, and psychomotor domains, provides a structured framework for defining and assessing graduated competency levels in young learners. Montessori's (1949) pedagogical philosophy further enriches this theoretical foundation, emphasizing prepared environments, child-led exploration, and intrinsic motivation as the engines of authentic competency development. Together, these theoretical frameworks converge on a shared vision of early childhood CBE: learning that is experiential, meaningful, socially embedded, and culminating in observable, transferable capability. Collectively, these theoretical perspectives converge on the view that competency development in early childhood is an active, developmental, and socially mediated process. Rather than focusing on knowledge acquisition alone, effective CBE promotes children's capacity to think, communicate, collaborate, and act independently in real-life situations. Consequently, early childhood learning environments should provide authentic, play-based, and inquiry-oriented experiences that enable children to demonstrate transferable competencies aligned with holistic child development.

2. Education for Sustainable Development and the SDGs

Education for Sustainable Development (ESD) positions education as a transformative force for achieving the SDGs. UNESCO's (2017) ESD learning objectives articulate three types of sustainability-related learning: cognitive (knowledge of sustainability challenges and solutions), socio-emotional (values, attitudes, and motivations that underpin sustainability behavior), and behavioral (action competencies). For early childhood, the socio-emotional and behavioral dimensions are particularly primary: young children do not need to understand the geopolitics of climate change, but they can develop genuine care for living things, habits of conservation, and practices of cooperation. Wiek, Withycombe, and Redman (2011) identified five key sustainability competencies: systems thinking, anticipatory thinking, normative thinking, strategic thinking, and interpersonal competence. While complex in their full expression, the early developmental precursors of each — noticing connections between things, imagining future consequences, valuing fairness, planning small actions, and cooperating — are entirely accessible to kindergarten-age children through appropriate activity design (Davis, 2010; Ärlemalm-Hagsér & Davis, 2014).

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Sterling's (2010) concept of transformative learning is also instructive: sustainability education should not merely inform students about the world's problems but should cultivate the inner dispositions — empathy, responsibility, agency — from which genuine sustainable action flows. This positions ESD in early childhood not as a knowledge transmission project but as a values and character cultivation project, entirely consistent with the humanistic educational philosophy of Maslow (1970) and Rogers (1969). Overall, the literature suggests that ESD in early childhood is fundamentally a process of cultivating sustainable values and action competencies through experiential learning. Therefore, early childhood education should integrate sustainability into children's daily experiences, fostering habits, attitudes, and collaborative behaviors that contribute to achieving the Sustainable Development Goals over the long term.

3. Connecting CBE and SDGs in Early Childhood: Toward an Integrated Framework

The integration of CBE and SDGs in early childhood education is both theoretically coherent and practically generative. Both frameworks share a commitment to meaningful, real-world outcomes over abstract, test-based knowledge. Both prioritize the development of the whole child — cognitive, social-emotional, and behavioral dimensions. And both position the teacher as a facilitator of learning experiences rather than a transmitter of pre-packaged content. Empirical work on this integration in ECE settings remains limited but promising. Studies from Scandinavia (Ärlemalm-Hagsér & Davis, 2014), Australia (Davis, 2010), and the OECD's comparative education research (OECD, 2018) converge on several shared findings: nature-based learning environments, project-based inquiry, service-learning, and community-connected activities consistently generate meaningful competency development and sustainability awareness in young children. The challenge is designing these experiences systematically, assessing them in developmentally appropriate ways, and ensuring teacher preparation and institutional support are adequate. The present study responds directly to this challenge in the Thai private kindergarten context. Taken together, the literature suggests that integrating CBE with the SDGs provides a comprehensive pedagogical framework for early childhood education that supports children's holistic development while preparing them to become competent and socially responsible citizens. This integrated framework provides the conceptual foundation for the present study, which investigates how competency-based learning can be implemented to advance the Sustainable Development Goals within the context of a Thai private kindergarten.

Methodology

1. Research Design

This study employed a mixed-methods design (Creswell, 2014), combining quantitative descriptive analysis of behavioral observation data and expert/teacher rating scales with qualitative content analysis of open-ended responses. The research was conducted in a single institution, making it a case study with embedded mixed-methods components. This design is appropriate for applied educational research aimed at generating context-specific, actionable findings while maintaining systematic rigor in data collection and analysis.

2. Research Setting and Participants

The study was conducted at Anuban Sampasa BanTonMai Trilingual Kindergarten, a private early childhood institution in the Huai Khwang District of Bangkok, Thailand. The school offers trilingual instruction (Thai, English, and Mandarin) within a project-based, nature-connected curriculum framework, making it a particularly apt site for exploring CBE–SDGs integration. Participants were selected using purposive sampling (Patton, 2002) based on developmental appropriateness and practical considerations. The study sample comprised:

1) 56 kindergarten children enrolled in Years 2 and 3 (ages approximately 4–6 years), representing the full cohort at these levels.

2) 8 classroom and subject teachers in Years 2 and 3.

3) 2 school administrators (including the Deputy Director/researcher).

Expert evaluation was provided by three external reviewers with established expertise in early childhood curriculum, CBE, and SDGs-integrated education (see Appendix A for profiles).

3. Instructional Framework and Prototype Activities

The integrated CBE–SDGs framework was operationalized through the design and implementation of two prototype learning activities during the first semester of 2025. Each activity was designed to (a) target specific CBE competencies, (b) connect to identified SDG targets, and (c) employ pedagogically appropriate experiential and inquiry-based learning methodologies.

Activity 1: ‘Growing Hands, Blooming Hearts' (Planting Activity)

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Children participated in a school vegetable garden project involving planting, tending, and harvesting produce for use in the school lunch program. Target competencies: communication, responsibility, and environmental care. Linked SDGs: SDG 2 (Zero Hunger), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land). This activity was designed to develop the CBE dimensions of personal responsibility through caring for living things, communication through group discussion and reporting, and environmental awareness through direct engagement with natural systems.

Activity 2: 'Exploring Insects in the Garden' (Nature Inquiry Activity)

Children conducted a guided nature inquiry in the school garden, observing, recording (through drawing and verbal description), and discussing insects encountered in the school environment. Target competencies: observation, systems thinking, and communication. Linked SDG: SDG 15 (Life on Land). This activity was designed to develop scientific observation, the beginnings of ecological systems thinking, and communication through multiple modalities (verbal, artistic, kinesthetic).

4. Data Collection Instruments

Three instruments were used, all subject to expert content validity review prior to implementation.

Activity Documentation Record

A structured observation record was completed by the lead teacher for each activity, documenting activity name, date, participant grade level, target competencies, linked SDGs, and materials used. This instrument served primarily as a process documentation tool.

Pre–Post Behavioral Observation Checklist

A teacher-completed behavioral observation checklist assessed each child's observable behavior across targeted competencies both before and immediately after each activity. Behaviors were rated on a three-level scale: 'Not Observed' (behavior absent or very infrequent), 'Sometimes' (behavior observed but inconsistently), and 'Consistently' (behavior reliably observed across contexts). The checklist was adapted from the Early Years Learning Framework (2022) and was reviewed by three content experts prior to use.

Teacher Reflection Questionnaire

Following each activity, participating teachers (n = 10, including administrators) completed an eight-item Likert-scale questionnaire (1 = Strongly Disagree to 5 = Strongly Agree) assessing: (a) observed child development in communication; (b) children's confidence in self-expression; (c) clarity of competency–activity alignment; (d) effectiveness in promoting language and listening skills; (e) teacher confidence in activity facilitation; (f) adequacy of resource support; (g) systematicity of assessment; and (h) opportunities for teaching reflection. Open-ended comment fields supplemented each item.

5. Validity and Ethics

Content validity of the teacher reflection questionnaire was established using the Index of Item-Objective Congruence (IOC) reviewed by three expert validators. IOC values ranged from 0.67 to 1.00 across all items, all above the accepted threshold of 0.50 (Rovinelli & Hambleton, 1977). One item initially rated 0 by one expert was revised following expert feedback; all items met validity criteria in the revised version.

Ethical considerations were addressed through informed consent from all participating teachers and school administrators. Parental consent for child participation was obtained through the school's existing research participation framework. Given that the researcher is also the Deputy Director of the school, potential positionality bias in data interpretation was mitigated through multiple data sources, transparent reporting, and external expert validation of the instructional framework.

6. Data Analysis

Quantitative data from the pre–post behavioral observation checklist were analyzed using descriptive statistics: frequency counts and percentage distributions of each behavioral level ('Not Observed,' 'Sometimes,' 'Consistently') before and after each activity. Expert evaluation and teacher questionnaire data were analyzed using means (M) and standard deviations (SD). Qualitative data from open-ended teacher responses were analyzed using content analysis (Creswell, 2014), organized into thematic categories: observed strengths of activities, developmental changes observed in children, and recommendations for further development.

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Results

1. Expert Evaluation of the Integrated CBE–SDGs Framework

The integrated CBE–SDGs instructional framework was evaluated by three external experts with backgrounds in early childhood curriculum development, CBE, and sustainability education. Table 1 presents the results.

Table 1. Expert Evaluation of the Integrated CBE–SDGs Framework for Early Childhood Education (n = 3)

Evaluation Criterion	M	SD	Interpretation
1. Accuracy of content and conceptual alignment with CBE and SDGs	5.00	0.00	Highest
2. Alignment with early childhood developmental trajectories	4.67	0.47	High
3. Appropriateness of the experiential learning process design	4.67	0.47	High
4. Feasibility of classroom implementation	4.33	0.47	High
5. Clarity of proposed activities and framework structure	4.67	0.47	High
6. Capacity to promote competency development in children	5.00	0.00	Highest
7. Appropriateness of supporting materials and tools	4.33	0.47	High
Overall Mean	**4.67**	**0.25**	**High**

Note. Scale: 5 = Highest, 4 = High, 3 = Moderate, 2 = Low, 1 = Lowest.

As shown in Table 1, the overall mean suitability rating was 4.67 (SD = 0.25), interpreted as 'High.' The two highest-rated criteria were conceptual accuracy and capacity to promote competency development (both M = 5.00, SD = 0.00), indicating unanimous expert agreement that the framework is theoretically sound and developmentally effective. Classroom implementation feasibility and adequacy of supporting materials received the lowest scores (both M = 4.33, SD = 0.47), though both remained at the 'High' level. Qualitative feedback from experts emphasized the need for a practical implementation guide with sample lesson plans and developmentally appropriate assessment tools, stronger connections to family and community learning, and structured reflection time within activity sequences to develop higher-order thinking skills.

2. Pre–Post Behavioral Observation Results

Tables 2 and 3 present behavioral observation data for the two prototype activities, showing the distribution of children across three behavioral levels (Not Observed, Sometimes, Consistently) before and after participation (N = 56).

Table 2. Pre–Post Behavioral Observation Results: Activity 1 — 'Grow with Our Hands, Grow with Our Hearts' (n = 56)

Competency	Pre-Activity (%)			Post-Activity (%)			Change (Consistent %)
	Not Obs.	Sometimes	Consistent	Not Obs.	Sometimes	Consistent	Δ
Communication	25	50	25	8	32	60	**+35%**
Responsibility	30	45	25	12	28	60	**+35%**
Environmental Care	35	40	25	10	25	65	**+40%**

Note. Percentages represent the proportion of children (N = 56) rated at each behavioral level.

Table 3 Pre–Post Behavioral Observation Results: Activity 2 — 'Exploring Insects in the Garden' (n = 56)

Competency	Pre-Activity (%)			Post-Activity (%)			Change (Consistent %)
	Not Obs.	Sometimes	Consistent	Not Obs.	Sometimes	Consistent	Δ
Observation Skills	20	55	25	5	35	60	**+35%**
Systems Thinking	40	35	25	15	40	45	**+20%**
Communication	25	50	25	8	32	60	**+35%**

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Across both activities, the most consistent gains were observed in communication (both activities: 25% → 60%, Δ +35%) and direct environmental interaction (Activity 1: environmental care 25% → 65%, Δ +40%). Systems thinking showed a smaller but meaningful gain (25% → 45%, Δ +20%), consistent with the greater cognitive complexity of this competency for the target age group. The 'Not Observed' category declined substantially across all competencies in both activities, suggesting genuine behavioral change rather than mere level-shifting.

3. Teacher Reflection Survey Results

Table 4 presents teacher reflection survey results (n = 10, including 8 classroom teachers and 2 administrators).

Table 4. Teacher Reflection Survey Results (n = 10)

Item	M	SD	Level
1. Children showed improved communication development	4.60	0.47	SA
2. Activities encouraged children to express themselves confidently	4.70	0.44	SA
3. Activities were clearly connected to targeted competencies	4.30	0.44	A
4. Activities effectively promoted language and listening skills	4.60	0.47	SA
5. I felt confident facilitating the activities	4.40	0.47	A
6. I received adequate support (resources and time)	4.20	0.38	A
7. I was able to assess children's behavior systematically	4.30	0.44	A
8. I had regular opportunities for teaching reflection	4.30	0.44	A
Overall Mean	**4.43**	**0.17**	**A**

Note. Scale: 5 = Strongly Agree (SA); 4 = Agree (A); 3 = Neutral; 2 = Disagree; 1 = Strongly Disagree.

The overall teacher reflection mean was 4.43 (SD = 0.17), interpreted as 'Agree.' The highest-rated item was 'Activities encouraged children to express themselves confidently' (M = 4.70, SD = 0.44). Three items reached the 'Strongly Agree' level: items 1, 2, and 4, all related to children's communication development — suggesting that the communication-competency dimension of the integrated framework was the most visibly effective in teachers' perceptions. The lowest-rated item was 'I received adequate support' (M = 4.20, SD = 0.38), pointing to a need for more institutional scaffolding. Importantly, 100% of teachers reported a desire to continue applying the CBE–SDGs framework in subsequent semesters.

4. Qualitative Findings: Teacher Observations and Recommendations

Content analysis of open-ended teacher responses yielded three thematic clusters.

Theme 1: Perceived Activity Strengths

Teachers consistently highlighted the value of direct, nature-based experience in stimulating authentic communication and sustained engagement. Representative responses noted that 'learning from real experience helps children connect and remember for a long time,' and that 'connecting learning with nature naturally stimulates curiosity and authentic language use.' Group communication formats were seen as developing both language skills and collaborative problem-solving simultaneously.

Theme 2: Observed Developmental Changes

Teachers reported qualitative changes in children's language production, listening behavior, social confidence, and creative problem-solving. Children were described as 'using more complete and complex sentences,' 'following more complex instructions after listening,' and 'suggesting their own solutions to problems.' These observations align with the quantitative

Theme 3: Recommendations for Development

Teachers' recommendations centered on four areas: (1) development of a comprehensive implementation guide with ready-to-use lesson plans and assessment protocols; (2) integration of digital tools and technology to support learning documentation and assessment; (3) creation of structured family and community engagement mechanisms, including 'Parent Education' sessions; and (4) institutionalization of regular teaching reflection time within the weekly schedule to support continuous

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improvement and build 'Voices to Share' sessions where children can engage in structured meaning-making and higher-order thinking.

Discussion

1. On the Appropriateness of the Integrated Framework

The high expert suitability ratings (M = 4.67) provide strong external validation that the proposed CBE–SDGs framework is conceptually coherent, developmentally appropriate, and pedagogically sound. The unanimous expert agreement regarding conceptual accuracy (M = 5.00) confirms that the framework is firmly grounded in both Competency-Based Education principles (Gervais, 2016; OECD, 2018) and Education for Sustainable Development (UNESCO, 2017). This finding is particularly meaningful because previous studies have noted that sustainability themes are often incorporated into early childhood curricula only superficially, without explicit alignment to competency development (Davis, 2010).

Although the framework received consistently high ratings, implementation feasibility (M = 4.33) and supporting materials (M = 4.33) were rated slightly lower than conceptual quality, indicating that translating the framework into routine classroom practice presents additional challenges. This finding reflects a common issue reported in competency-based education research, where teachers frequently require practical guidance, assessment tools, curriculum exemplars, and sustained professional development before innovative pedagogies can be implemented consistently (Mulder, 2017; Fullan, 2013). In the present study, the pilot implementation benefited from close researcher support within a well-resourced private trilingual school. Broader implementation, however, would require comprehensive teacher training, ready-to-use instructional materials, competency assessment rubrics, collaborative planning time, and leadership support. These operational requirements should be considered essential components of future implementation strategies rather than supplementary resources.

2. On the Effectiveness of CBE–SDGs Activities

The pre–post behavioral observation data provide preliminary evidence that CBE–SDGs integrated activities can promote meaningful competency development among young children. The largest improvements occurred in communication and environmental responsibility, supporting previous research suggesting that authentic interaction with natural environments enhances children's language use, social participation, and environmental awareness (Ärlemalm-Hagsér & Davis, 2014; Davis, 2010). The comparatively smaller improvement in systems thinking (Δ +20%) is also consistent with developmental theory. According to Piaget (1952), children aged four to six years are typically in the pre-operational stage, during which reasoning remains largely concrete and egocentric. Consequently, understanding complex ecological interrelationships develops gradually rather than immediately. Rather than expecting young children to comprehend complete environmental systems, instructional activities should progressively scaffold systems thinking through age-appropriate pedagogical strategies. Such strategies may include sequential storytelling illustrating ecological cause-and-effect relationships, concept mapping with visual supports, guided questioning, repeated observation of natural cycles, collaborative discussions, and project-based investigations that allow children to revisit interconnected phenomena over time. These scaffolded experiences may better support children's emerging ability to recognize relationships among living organisms and environmental processes. Nevertheless, the findings should be interpreted cautiously. Behavioral improvements were measured immediately following two prototype learning activities using teacher observations without comparison groups or standardized assessment instruments. Therefore, the study demonstrates promising preliminary evidence rather than definitive causal effects. Longitudinal studies involving multiple schools and more rigorous experimental designs are needed to examine the long-term development of sustainability-related competencies.

3. On Teacher Readiness and Institutional Conditions

The unanimous teacher intention to continue implementing the CBE–SDGs framework reflects strong practitioner acceptance and perceived educational value. Teachers reported that the integrated activities enhanced children's participation, communication, and environmental awareness while remaining compatible with existing classroom routines. Such positive perceptions are consistent with previous studies emphasizing teacher ownership as an essential condition for successful educational innovation (Fullan, 2013). However, the relatively lower rating for institutional support (M = 4.20)

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highlights that teacher commitment alone is insufficient for sustainable implementation. Effective adoption of competency-based sustainability education requires enabling organizational conditions, including school leadership support, adequate instructional resources, collaborative planning opportunities, continuous professional learning, and ongoing mentoring. These findings suggest that successful implementation depends not only on pedagogical innovation but also on institutional readiness. Future research should therefore examine organizational capacity-building strategies alongside instructional effectiveness, particularly in public schools and educational settings with more limited resources.

Conclusion

This study examined the appropriateness and preliminary effectiveness of integrating Competency-Based Education (CBE) with the Sustainable Development Goals (SDGs) in an early childhood educational setting. The findings indicate that the proposed framework demonstrated high conceptual appropriateness, positive teacher acceptance, and encouraging improvements in children's communication, environmental responsibility, and emerging systems thinking following participation in two prototype learning activities. Collectively, these results suggest that integrating competency-based learning with sustainability education is a feasible and developmentally appropriate instructional approach within the context of this study.

The study offers several practical implications. For curriculum developers, it illustrates how SDGs can be translated into developmentally appropriate competency-based learning experiences. For teachers, it emphasizes the value of explicit competency mapping, reflective instructional practice, and authentic nature-based learning activities. For school leaders, the findings highlight the importance of sustained professional development, collaborative planning, and institutional support to facilitate successful implementation.

The study also contributes theoretically by proposing an integrated framework that connects competency-based education with sustainability education in early childhood contexts, extending current conceptual models through explicit alignment between competency development and SDG-oriented learning outcomes.

However, these findings should be interpreted within the limitations of the study. The research was conducted in a single private trilingual kindergarten with a relatively small sample and a short implementation period. Consequently, the findings should not be generalized directly to public schools or educational settings with different institutional contexts, teacher capacities, or resource availability. Further research involving larger and more diverse samples, longitudinal designs, and multiple educational contexts is needed to examine the scalability, adaptability, and long-term effectiveness of the CBE–SDGs framework across Thailand's early childhood education system.

Suggestions

Suggestions for Future research

Comparative studies across diverse school contexts (rural/urban, public/private, high-resource/low-resource) to establish the boundary conditions of CBE–SDGs integration in ECE.

Longitudinal studies tracking competency development and sustainability attitudes into primary school.

Design and validation of standardized, developmentally appropriate assessment tools for CBE–SDGs competencies in ECE.

Investigation of family and community engagement as mediating variables in the effectiveness of school-based sustainability education.

Exploration of digital learning tools that support CBE–SDGs documentation and assessment while maintaining the embodied, sensory-rich character of early childhood learning.

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