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Design and Application of BOPPPS Teaching Module based CBVE for Higher Vocational Curriculum for Infant and Childcare In China

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Abstract

Background: The first 1000 days are vital for brain development. China needs high-quality childcare talent cultivation.
Significance: Theoretically enriches CBVE-BOPPPS integration and practically expands curriculum reform.
Aim: Design and implement ICCC within the CBVE framework.
Objectives: Develop design, compare scores, and explore teachers' strategies.
Methods: Use DDR based on ADDIE, with 32 in CBVE-BOPPPS and 30 in TTM groups.
Findings: CBVE-BOPPPS outperformed; teachers faced challenges and used multiple methods.
Implications: Validates effectiveness and offers new views.
Limitations: Small sample, limited time, needs long-term tracking.

Keywords: Competency-Based Vocational Education; BOPPPS teaching model; Design and Development Research; ADDIE Instructional design models;

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1.0 Introduction

Existing talent cultivation models for childcare professionals reveal multiple shortcomings. For instance, admission processes often lack systematic screening mechanisms to assess students' vocational aptitude and emotional intelligence, leading to low professional commitment (Wu et al., 2022). Curricula tend to prioritize theoretical knowledge over practical skills, with limited integration of real-world case studies or hands-on training, which weakens graduates' job readiness (Li & Yang, 2023). Pedagogically, traditional lecture-based methods dominate, failing to engage students in active learning and critical thinking (Wang & An, 2023b). These issues collectively result in a mismatch between graduates' competencies and industry requirements, undermining the sector's service quality.

Against this backdrop, this study proposes a innovative curriculum design for infant and childcare programs in Chinese vocational colleges, integrating Competency-Based Vocational Education (CBVE) and the BOPPPS teaching model within the ADDIE instructional design framework. CBVE's competency-driven approach (Misbah et al., 2022) provides a robust foundation for aligning curricula with occupational standards, while the BOPPPS model's student-centered, six-stage framework (Li et al., 2024) enhances classroom engagement and skill acquisition. By adopting ADDIE's systematic phases , this study aims to create a closed-loop curriculum that

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addresses industry needs, cultivates practical competencies, and improves teaching effectiveness. The proposed model seeks to revolutionize talent cultivation by fostering graduates with both professional proficiency and pedagogical innovation, thereby supporting China’ s transition to a "population quality dividend" and elevating the professionalism of its early childhood care sector.

2.0 Literature Review

2.1 Infant and Childcare Curriculum (ICCC)

Infant and childcare Curriculum (ICCC) is a science that uses knowledge of health and nutrition to protect children's health and improve their well-being (Yang & Wang, 2022). However, the old ICCC content set does not meet the demand, and new technology requires the integration of health, safety, and education (Wu et al., 2022). Although researchers have linked occupational skills to certificates (MEO, 2019), the hierarchical division hinders student learning and calls for curriculum reconstruction. Therefore, this study will incorporate the ADDIE structured model to provide guidance for ICCC design (Adeoye et al., 2024).

2.2 The Competency-Based Theory of Vocational Education (CBVE)

Competency-Based Vocational Education (CBVE) was proposed as the antithesis of the traditional lecture method (Rahman et al., 2022). Currently, there are different tendencies in defining CBVE. These include educational theories, frameworks, instructional models, and models. However, regardless of the definitional tendencies, the ultimate goal is to help students improve their knowledge, skills, and attitudes in their respective occupations through systematic training (Qin, 2024). This is due to the fact that CBVE has achieved better results in the application of student achievement and occupational competence (Misbah et al., 2022). Even some research progress has been made at the level of curriculum development and instructional reform (Herinckx et al., 2024).

However, currently, there is no relevant research on incorporating CBVE at the level of ICCC design and implementation. Therefore, this study can explore the path of curriculum development for ICCC provision from the perspective of infant and toddler caregivers' occupational competencies

2.3 The BOPPPS Teaching Model

The BOPPPS teaching model, grounded in the theory of effective teaching and humanism, comprises "bridge in," "objective," "pre-assessment," "participatory learning," "post-assessment," and "summary." It emphasizes students' participation and feedback in teaching (Fenrich & Johnson, 2016). After years of practice, it has become a guiding teaching theory in North American courses. It is gradually applied in vocational education curriculum reform in China, especially in medical-related fields (Hu et al., 2022).

Current research on BOPPPS compares it with traditional models (Hu et al., 2022) or integrates it with other models (Li et al., 2023). Such studies have shown that BOPPPS can boost student achievement (Hu et al., 2022), engagement (Yu, 2023), etc. Only one study combines BOPPPS with OBE theory (Di et al., 2021). This study will innovatively integrate CBVE and BOPPPS to design an instructional program for an infant and childcare curriculum.

3.0 Research Objective

Research Objective 1:To develop a core occupational competency indicator and instructional design based on the BOPPPS teaching model under the Theory of Competency-Based on Vocational Education (CBVE) for teaching the infant and childcare curriculum.

Research Objective 2:To compare the differences between the group which exposed to BOPPPS teaching model based on CBVE theory and the group exposed to traditional the teaching model in terms of mean scores on Student Preformance and Learning engagement in learning (UWES-S).

Research Objective 3:To explore the challenges and strategies teachers face in designing and implementing an infant and childcare curriculum (ICCC) based on the BOPPPS model of teaching and learning guided by CBVE theory.

4.0 Methodology

The research method used in this study is Design and Development Research (DDR) (Jaya et al., 2021), which combines the instructional design model ADDIE to deductively construct an ICCC instructional design based on the BOPPPS instructional model under the theory of CBVE vocational competency education through the design, development, implementation, and evaluation phases. And verify the effectiveness of this teaching model on students' learning of infant and child care courses. In the analysis phase, the core CBVE and CBVE-BOPPPS design recommendations for the ICCC were obtained through expert interviews; in the design phase, the ‘product’ of the core CBVE and CBVE-BOPPPS instructional design for infant and child care was designed through the combination of expert recommendations and literature analysis; and in the development phase, the ICCC instructional design was developed by three experts, each of whom provided expert content for the instructional design. In the development phase, three experts conducted expert content validity tests on the instructional designs and calculated PCM values (Percentage Calculation Method); in the implementation phase, the CBVE-BOPPPS and Traditional Teaching Model groups conducted quasi-experimental studies; and in the evaluation phase, and analyzed the CBVE-BOPPPS and CBVE-BOPPPS instructional designs to determine whether they were effective. A quasi-experimental method was conducted; the assessment phase analyzed the comparison of the two groups' academic performance and

learning engagement as well as the interviews of the instructors about the strategies adopted during the implementation of the CBVE-BOPPPS group. Figure 1 illustrates the specific steps in the ADDIE teaching model.Figure 1 shows ADDIE's steps.

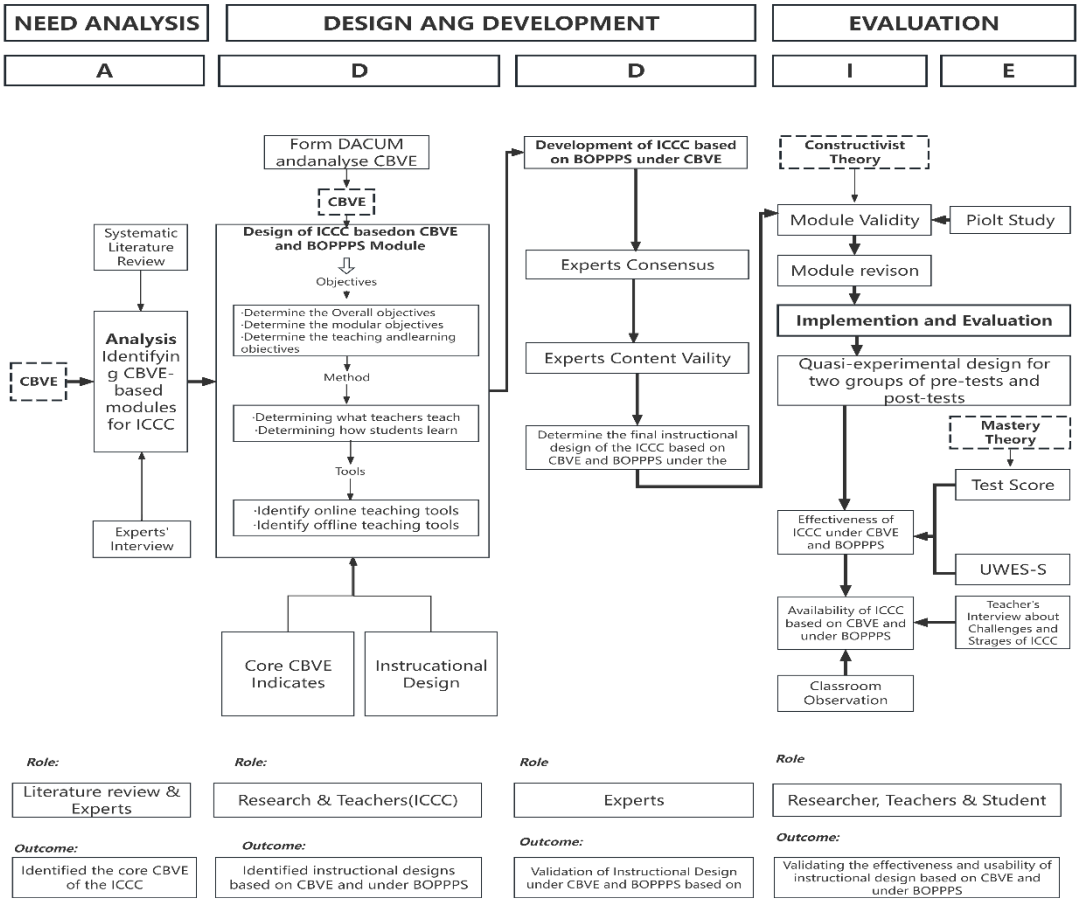


Fig. 1: Steps of the ADDIE teaching model

5.0 Findings

5.1 Analysis

5.1.1 Document Analysis

The first stage of the ADDIE model is analysis, which begins with a literature review. The search was conducted through international and national databases, including ERIC, Scopus, "CNKI, Wanfang" and documents published by government or national organizations. Combining the four stages of the systematic literature review (SLR) methodology, namely identification, screening, qualification, and inclusion (Nunes et al., 2016), 21 relevant literatures and policies were finally reviewed. Then, the thematic analysis method presents the coding results below in Figure 2.

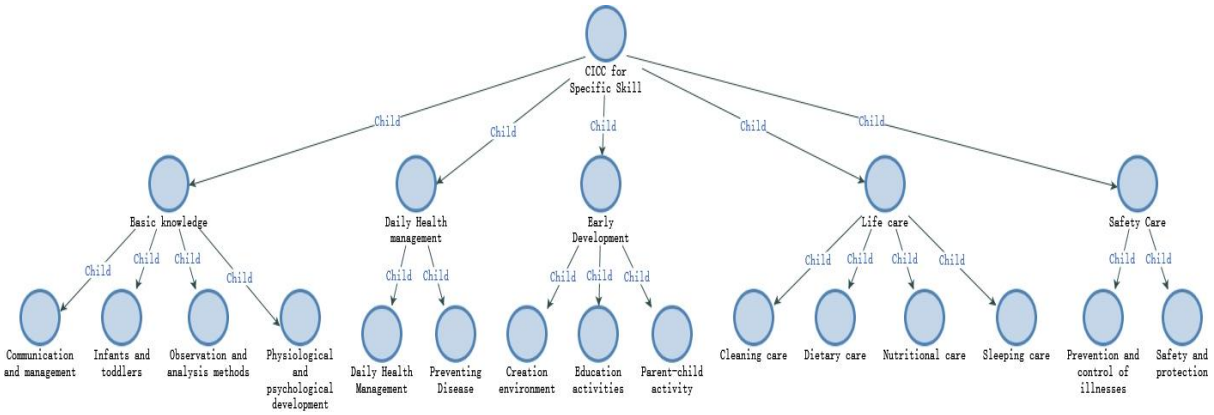
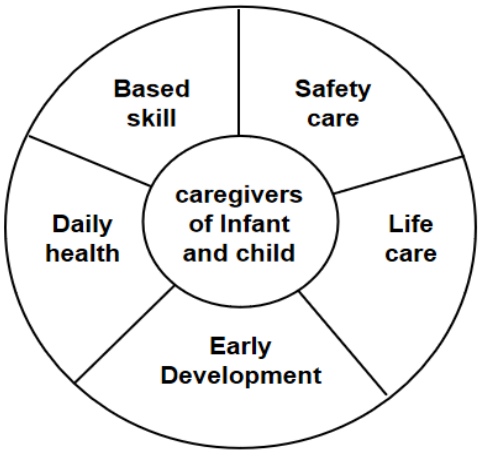


Fig. 2: Core Occupational Competencies Required of Infant and Toddler Caregivers

The above coding results are based on the policies and literature reviewed using the SLR method to screen for required professional competencies for infant and toddler caregivers. A total of five categories of (1) basic knowledge, (2) early development, (3) safety care, (4) life care, and (5) daily health management were identified through the thematic analysis method. Secondly, the DACUM committee members of CBVE brainstormed (teachers of NP college). Basic skills could be integrated into the other four modules due to the foundational nature of the competencies. Thus, Figure 3 illustrates a comprehensive competency map for infants and childcare.



. Fig. 3: Core CBVE for Infant and Toddler Care

5.1.2 Expert interviews

Six experts were selected, including experienced kindergarten teachers, kindergarten directors, and heads of higher education institutions. After the interviews, coding was done through thematic analysis, and the data results were analyzed using Nvivo 12plus. The coding themes are shown in Figure 4.

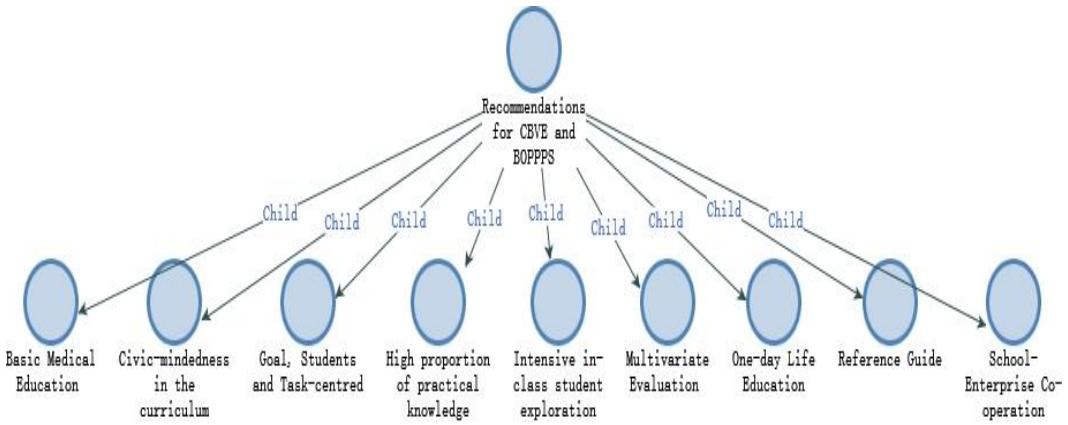


Fig. 4: Recommendation of ICCC

Recommendations on CBVE-BOPPPS focus on CBVE and BOPPPS levels. CBVE includes "basic medical education," "Reference Guide," "citizenship in the curriculum," "school-business cooperation," and "One-day life education," with experts giving related suggestions (IT, EX1-6, 2024). For BOPPPS, experts suggest three approaches: "high levels of practical knowledge," "Goal-, student- and task-centered," "Intensive in-class student exploration," and "Multiple Assessment," involving curriculum integration, student clarification, etc. (IT, EX1-3, 2024).

5.2 Design

The design phase consisted of four steps. First, the CBVE-BOPPPS modules were recoded and reclassified, considering comments from expert interviews and incorporating Peng et al.'s (2020) 1 + X certificate in early childhood care. Second, the overall module and task objectives of CBVE-BOPPPS were designed in conjunction with CBVE theory. In addition, teaching methods such as the task-driven method and the situation-creating method were incorporated with experts' suggestions for the implementation of BOPPPS. Finally, teaching strategies suggested by experts were incorporated into the instructional design. These include course ideology, reference standards, and task centers. Finally, the instructional designs for the CBVE-BOPPPS and TTM groups were developed, as shown in Tables 1 and 2, respectively.

Table 1. An example of CBVE-BOPPPS's Instructional Design

Teaching session	Teaching method	Teaching content	Teaching time
Before Class	Task-Driven	Understanding CBVE：Task-Driven Approach Study Pass Releases 'Understanding the Skin Manifestations and Grades of Burns'	Self-organisation
Bridge in	Case study method	Introducing CBVE: Play a case in a real childcare situation where a baby spills a cup of soup and lies on his arm crying, and the baby carer fails to assess in time to take a small towel to wipe it off, but this leads to broken blisters. Determine CBVE: In the context of the case students will brainstorm and state the teaching objectives regarding the treatment of burns. Teacher summarises and presents the teaching objectives	5min
Objective	Task-driven approach	a.Cognitive Objectives：Be able to determine the extent and grade of burns in a child with burns b.Competency target：Be able to perform the initial treatment of a burned child with the five-step treatment of scald. c.Quality objective：Be able to have an awareness of safety issues identification	4min
Pre-assessment	Quiz Method	Pre-test CBVE: Show quiz questions a.Please select, what is the grade of burn with blister formation, localised wetness and pain? b. Please select the five correct steps for burns in young children?	5min
Participatory-Learning	a. Lecture method b. Group discussion method c. Group role-playing method	Participate in CBVE: a.Teacher presents pictures of the four levels of burns in young children in relation to the questions in the quiz to provoke students to think carefully b. Discuss how to avoid and treat burns in a childcare setting. c. Teacher demonstrates the five steps in the initial treatment of burns: 'Flush - Take off - Soak - Cover - Send'. d. Group work to practise the five steps of scald treatment e.Role-play demonstrating the five steps of burns management	3min 5min 10min 22min 30min
Post-assessment	Quiz Method	Post-test CBVE: a.Analyse the level of scald in relation to the picture is? b.Take and video of the five steps of scald management within the time limit	4min
Summary	Task-driven approach	Summarise CBVE: Guide students to summarise the key learning points and identify the importance of CBVE learning. Work together to create a mind map.	2min
After Class	Task-driven approach	Extended CBVE: Watch a step-by-step video of a medical professional handling a burn	Self-organisation

Table 2. An example of a Traditional Teaching Model's Instructional Design

Link	Teaching Method	Teaching process	Teaching time
Before class	Case Study Method	Teachers post teaching resources and preview tasks on the learning platform for scalded young children	Self-organisation
In Class	Questioning method	Please answer Is it correct to analyse infant and childcare in pre-school tasks? Why?	5min
	Intuitive method	Teacher presents Teacher presents pictures of the four grades of burns in young children to stimulate students to think carefully	5min
	Lecture method	Explain the four grades of burns and the results of burns in young children to stimulate students' thinking.	5min
	Discussion method	Discuss how to avoid and handle burns in childcare centres.	5min
	Lecture method	Explain the steps and procedures for the initial treatment of burns in young children, with students taking notes.	10min
	Demonstration method	Teacher demonstrates the five steps in the initial treatment of burns: 'Rinse - Strip - Soak - Cover - Deliver'.	15min
	Exercise method	Students practise the five steps of burns treatment independently, while the teacher goes round to guide and ask questions.	40min
	Lecture method	Summarise the specific symptoms of burns and the steps of initial treatment of burns, and lead students to make a mind map of the five-step method.	5min
After Class	Task-driven method	Watch a video of a professional doctor handling burns.	Self-organisation

5.3 Development

The evaluation questionnaire was developed concerning Russell's (1974) scoring indicators to validate the professional competency match and the session and activity content validity of the CBVE-BOPPPS instructional design. The rating experts consisted of one infant and childcare expert and two childcare organization experts who rated the provided instructional design on a scale of 1-10 (strongly disagree to agree strongly). The method of analysis was PCM, and the Cronbach coefficient was calculated. The results of this study were that the reliability coefficient of the professional competence match was 0.779, reaching 89.3% content validity, and the reliability coefficient of the chapter and activity validity was 0.75, reaching 81.9% content validity. The PCM value of both results reached 70%, which proves that the instructional design of CBVE-BOPPPS has good content validity.

In addition, experts made recommendations for CBVE-BOPPPS, including that CBVE can design a separate module for environment creation alone. Clarify the monthly age group and operation steps in the specific operation. Pay attention to the professionalism and scientificity of the operation terminology.

5.4 Implementation

The implementation phase lasted 3 months of teaching and learning activities. Both groups remained the same except for the differences in the teaching mode. The instructors were three from the medical, educational, and nursing professions who had uniformly participated in the CBVE-BOPPPS training. The number of participating students was 32 in the experimental group and 30 in the traditional teaching model group. The textbook was Certificate in Infant and Childcare. The classrooms were all infant and toddler care and early education practicum rooms. The class schedules were all scheduled for 16 weeks and 64 credit hours. Threats to the validity of quasi-experimental research were minimized (McMillan & Schumacher, 2001).

5.5 Evaluation

Evaluation is the final stage of the ADDIE instructional design model. It focuses on analyzing the differences between the experimental group and the traditional teaching group in terms of performance and learning engagement in the ICCC

5.5.1 Student performance

5.5.1.1 Normal Distribution Test for Scores

The CBVE-BOPPPS and TTM groups were tested for normal distribution before the independent samples t-test was performed. The table results show that as a small sample (not more than 50 people), the test was conducted using Shapiro-Wilk. The results show that the p-value of the pretest and post-test is more significant than 0.05, and the results are normally distributed for the paired samples t-test and the independent samples t-test.

Table 3. Normal Distribution Results for Academic Achievement

Variant	Group	Sta.	df	P
Pre-test	CBVE-BOPPPS	0.951	32	0.150
	TTM	0.931	30	0.051
	CBVE-BOPPPS	0.954	32	0.216
Post-test				
	TTM	0.988	30	0.975

5.5.1.2 Examination of CBVE-BOPPPS and TTM

Examination of the results of the pretest and post-test of CBVE-BOPPPS and TTM showed no difference between the pretest of the CBVE-BOPPPS group and the TTM group. However, at the post-test stage, the CBVE-BOPPPS group was significantly higher than the TTM group. It proves that the BOPPPS teaching model based on CBVE theory is more helpful in improving students' infant and child care performance than the traditional teaching model. The table shows the differences in post-test scores between the two groups.

Table 3. Post-test results of academic performance

Group	RS*	ER*
CBVE-BOPPPS	32	82.234±6.87
TTM	30	76.183±8.10
t		3.179
p		0.02

5.5.2 Learning Engagement

Li Xiying applied the learning engagement scale, which was adapted from Schaufeli et al.'s (2002) Learning Engagement Scale (UEWS-S). The scale analyzes the degree of college students' engagement in learning through three dimensions (vitality, dedication, and Absorption) and 17 items. This study generated and analyzed questions 1-6, 6-11, and 12-17 of the three dimensions as variables VI1-VI6, DE1-DE5, and AB1-AB6, respectively.

5.5.2.1 Kurtosis and skewness tests

Due to the presence of non-normality in the normality distribution test for the CBVE-BOPPPS and TTM groups requires further testing of the kurtosis and skewness values. Combined with the table results, the Z-values of Kurtosis and skewness for both groups are within ±2.5, indicating that none of them deviates significantly from the normal distribution, and the parametric test can be applied.

5.5.2.2 Test of CBVE-BOPPPS and TTM

Examination of the pretest and post-test results of the UWES-S of CBVE-BOPPPS and TTM revealed no difference between the pretests of the CBVE-BOPPPS and TTM groups. However, at the post-test stage, the CBVE-BOPPPS group was significantly higher than the TTM group. Meanwhile, there was no significant difference between the pretest and post-test of the absorption dimension of CBVE-BOPPPS. There was no significant difference between the three pretest and post-tests of the TTM group. This result proves that the BOPPPS teaching model based on CBVE theory is more helpful than the traditional one in improving students' learning engagement in the infant and childcare curriculum. However, the table Absorption of the CBVE-BOPPPS group still needs to be improved. The table shows the differences in the post-test scores between the two groups and the specific differences in the three dimensions of the pretest and post-test for the CBVE-BOPPPS group.

Table 4. Independent Sample test of UWES-S

Independent Sample Test										
		Levine's test of variance equivalence		T-test for Equality of Means					95% Confidence interval of the Difference	
		F	Sig.	t	df	Sig.(2-tailed)	Mean Difference	Std.Error Difference	Lower	Upper
Post-tested VI	Equal variances assumed	3.977	.051	2.580	60	.012	.53090	.20576	.11933	.94248
	Equal variances not assumed			2.602	57.940	.012	.53090	.20406	.12242	.93939
Post-tested DE	Equal variances assumed	1.119	.294	3.744	60	.000	.69208	.18486	.32231	1.06185
	Equal variances not assumed			3.755	59.970	.000	.69208	.18433	.32337	1.06080
Post-tested AB	Equal variances assumed	1.071	.305	3.695	60	.000	.73924	.20005	.33908	1.13939
	Equal variances not assumed			3.709	59.862	.000	.73924	.19931	.34055	1.13792

Table 5. Pairing Sample test of CBVE-BOPPPS

	(math.) pairing difference					t	df	Sig.(2-tailed)
	Mean	Sta.Deviation	Standard error mean	95% Confidence interval of the Difference				
				Lower	Upper			
Pre and Post-test of VI	-.47396	1.12012	.19801	-.87781	-.07011	-2.394	31	.023
Pre and Post-test of DE	-.57500	.93222	.16479	-.91110	-.23890	-3.489	31	.001
Pre and Post-test of AB	-.33854	1.10998	.19622	-.73873	.06165	-1.725	31	.094

5.5.3 Challenges and strategies for designing and implementing ICCC

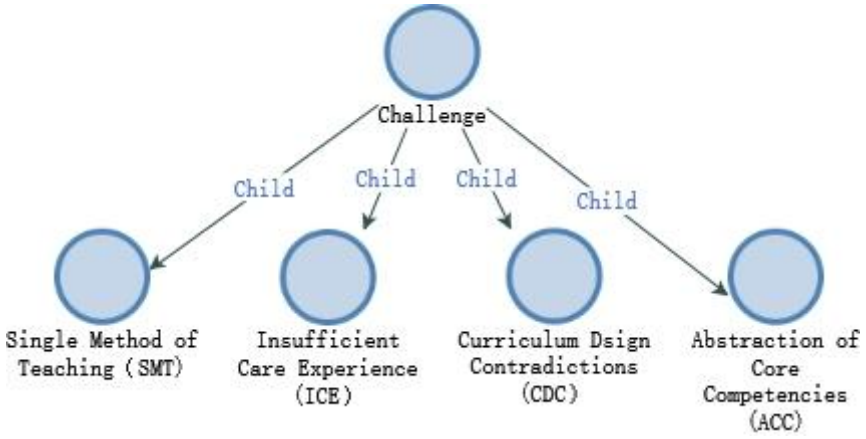


Fig. 4: Challenges for designing and implementing ICCC

At the end of the assessment, the challenges and strategies for designing and implementing CBVE-BOPPPS were conducted with the instructors and the data collected were analyzed using thematic analysis. As shown in Figure 4, challenges included students' lack of nursing experience, abstraction of CBVE core competencies, contradictory CBVE curriculum design and a single BOPPPS teaching methodology.

As shown in the Figure 5, the strategies includes Multi-centred teaching and learning philosophy, CBVE core content student participation as the main teaching methodology and a combination of process and summative teaching and learning assessment.

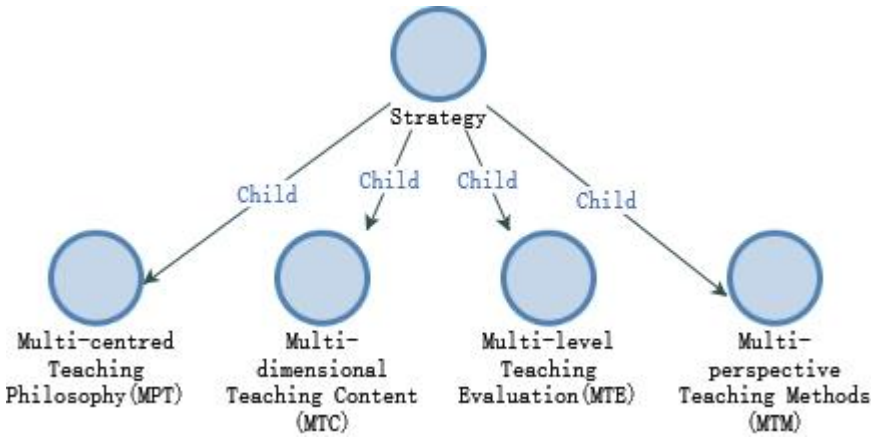


Fig. 4: Stragies for designing and implementing ICCC

6.0 Discussion

6.1 CBVE-BOPPPS is more helpful than TTM in improving students' academic achievement

Pre- and post-test results on academic achievement reveal that both the CBVE-BOPPPS and TTM groups enhanced their performance after the ICCC. However, the CBVE-BOPPPS group's post-test scores were notably higher, consistent with research highlighting the value of active teaching reforms (Cui & Wang, 2008). This shows the positive role of CBVE and BOPPPS in improving achievement (Hu et al., 2022; Wen et al., 2022).

Analysis-stage expert opinions indicated that the ICCC core CBVE of the CBVE-BOPPPS group should be designed practically for vocational students, focusing on students' vocational competencies. BOPPPS, grounded in cognitive and social constructivist theories (Piagte, 1976; Vygotsky, 1978), centers on students and uses various strategies. TTM, based on behaviorist theory (Skinner, 1954), overemphasizes teachers and has less student participation. With clear standards and formative feedback, the CBVE-BOPPPS model is more effective in improving student achievement than the traditional one..

6.2 CBVE-BOPPPS is more helpful than TTM in increasing students' learning engagement, but care should be taken to maintain the level of attractiveness.

Regarding the pretest and post-test results of the Learning Engagement Scale (UWES-S) for the CBVE-BOPPPS and TTM groups, the CBVE-BOPPPS group had significantly higher post-test Learning Engagement scores. The CBVE-BOPPPS group's post-test Absorption did not differ much from the pretest, and the TTM group's post-test Vitality, Dedication, and Absorption showed no significant changes. This shows that students in the CBVE-BOPPPS group were more engaged. As studies indicate, vitality relates to classroom experience and working relationships (Kiuru et al., 2014), dedication to learning enthusiasm (Ruiz-Alfonso et al., 2023), etc., and Absorption to professional competence (Liu & Yang, 2017), etc. CBVE-BOPPPS, designed with professional competency and emphasizing interaction, explains its higher engagement scores than TTM.

In addition, there was no significant difference in the pre-and post-tests of Absorption for the CBVE-BOPPPS group. In conjunction with the teacher interviews, it is clear that the challenges of the student's lack of experience in infant and childcare and the abstraction of the core competencies arose in the design of the CBVE-BOPPPS. When students lacked the practical experience, and prior learning to understand the abstract core CBVE, they could not understand the nature of the professional competencies well. To research, it is known that CBVE must consider the needs of learners' practical situations. Fragmentation of CBVE options and skills should also be avoided (Johnstone & Soares, 2014).

7.0 Conclusion & Recommendations

This study reconstructed ICCC content under CBVE-based BOPPPS. A quasi-experiment showed that the model boosted academic performance and engagement. Qualitative findings offered design/implementation suggestions and instructor strategies. Future research can follow up, expand samples, explore research paradigms, and incorporate IT training to develop intelligent tools for infant care education.

8.0 Limitation

This study has limitations. First, its sample size and regional/institutional focus may limit representativeness for broader infant care education and student demographics. Second, the quasi-experimental design's temporal and environmental constraints require long-term follow-ups to validate the curriculum model's sustainability. Third, evolving societal needs demand continuous refinement of targeted vocational competencies. Lastly, cultural differences in students' acceptance of the instructional model necessitate adaptation for broader applicability.

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Paper Contribution to Related Field of Study

This study reconstructed the core CBVE of the infant and child care curriculum at the theoretical level by innovatively integrating CBVE theory and the BOPPPS instructional model. At the practical level, it optimized student achievement and learning engagement through instructional design and pedagogical reform. Teachers' teaching skills were enhanced, their teaching methods were improved, and the shortcomings of the teaching model were addressed. It also provided a curriculum perspective for the training of early childhood educators.

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