

Research Article

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Developing an early childhood Pre-Service Teacher Instructional Model Based on Meaningful Learning Theory to Improve Lesson Design Ability

Zhao Ting, Chowwalit Chookhampaeng, Jiraporn Chano

Abstract

Background/purpose. This research aimed to study the basic information and needs for the development of an instructional model based on meaningful learning theory to improve lesson design ability for early childhood Pre-Service teachers, develop the model, and study the results of implementation.

Materials/methods. The sample group consists of two classes of second-year students majoring in Early Childhood Education at Xichang Minzu Preschool Normal College, with 30 students in the experimental group and 30 students in the control group. The sampling method is cluster random sampling. The research tools include student questionnaires, teacher interview outlines, course syllabus, and Lesson design ability tests.

Results. The study found that the existing courses have problems such as a lack of case resources, insufficient practical experience, a single teaching method, and a lack of learner autonomy. The developed model consisted of 6 components, including principles, objectives, syntax, social system, principle of reaction, and support system.

Conclusion. The results of implementation showed that students' overall lesson design ability and various dimensions have been significantly improved. After learning through the developed model, the students' lesson design ability scores are higher than those of students through traditional teaching, which is statistically significant (0.05).

1. Introduction

Teachers are the core of education and play a decisive role in students' learning outcomes. The Outline of the National Medium- and Long-term Education Reform and Development Plan (2010-2020) (Ministry of Education of China, 2010) states: "Teachers are the foundation of education." Research shows that teachers' teaching level directly affects students' learning outcomes (Hattie, 2015).

Lesson design ability is an essential part of teachers' teaching competence and a fundamental requirement for professional qualifications (Guo, 2019). In the teacher qualification examination, lesson design ability is a core evaluation criterion that directly impacts teaching quality and professional development (Qiao, 2019). The Professional Standards for Kindergarten Teachers (Trial) (Ministry of Education of China, 2012) explicitly requires kindergarten teachers to possess the ability to plan and implement educational activities. Therefore, enhancing the lesson design ability of preschool education students helps them internalize teaching theories, improve practical skills, and promote professional growth (Guo, 2019).

However, preschool education students still face many challenges in lesson design ability, such as unreasonable activity objectives, inadequate preparation, and ineffective process organization (Guo, 2019). The main reasons include weak self-directed learning awareness, lack of teaching experience, insufficient mastery of teaching methods, limited faculty resources, and inadequate off-campus teaching practice conditions (Li, 2020). To address these issues, it is necessary to innovate instructional models to effectively enhance the lesson design ability of preschool education students. The Outline of the National Medium- and Long-term Education Reform and Development Plan (2010-2020) emphasizes "deepening teacher education reform and innovating training models" to strengthen teachers' lesson design ability.

Currently, many studies focus on strategies to improve kindergarten teachers' lesson design ability, such as optimizing teaching content, improving teaching methods, offering training programs, and using information technology. However, existing research has the following limitations: 1) Most studies focus only on teaching strategies without proposing a systematic instructional model; 2) Many rely on existing models with limited practical application; 3) Most studies on lesson design ability improvement target primary, secondary, and university teachers, with little attention to kindergarten teachers.

Therefore, this study takes early childhood pre-service teachers as the research subjects and develops a new instructional model based on Rogers' meaningful learning theory to enhance their lesson design ability.

Although existing research provides strategies such as optimizing teaching content, improving methods, and offering training programs, it often lacks a systematic, theory-driven instructional model tailored to early childhood pre-service teachers. Most studies focus on in-service teachers, rely on generalized models with limited applicability, or target other education levels such as primary or secondary education. Very few address the specific needs, developmental characteristics, and contextual challenges faced by early childhood education students, especially in normal colleges. These gaps underscore the necessity of this study, which seeks to develop and evaluate a theoretically grounded instructional model based on meaningful learning theory to enhance lesson design ability among pre-service kindergarten teachers.

1.1. Research Questions

(1) What is the basic information of developing an instructional model based on meaningful learning theory to improve the lesson design ability of early childhood pre-service teachers?

(2) What are the components of the instructional model developed based on meaningful learning theory to improve the lesson design ability of early childhood pre-service teachers?

(3) What are the results of implementing the developed instructional model, which is based on meaningful learning theory, to improve the early childhood pre-service teachers' lesson design ability in a normal college?

1.2. Research objectives

(1) To study the basic information of developing an instructional model based on meaningful learning theory to improve the lesson design ability of early childhood pre-service teachers.

(2) To develop an instructional model based on meaningful learning theory to improve the lesson design ability of early childhood pre-service teachers.

(3) To examine the results of implementing the developed instructional model based on meaningful learning theory in improving the lesson design ability of early childhood pre-service teachers in a normal college.

2. Literature Review

2.1. The Course of Early Childhood Lesson Design

According to the standards set by the Ministry of Education of China (2017) for the accreditation of preschool education programs, early childhood education is a core component in the training of pre-service early childhood educators. According to the Ministry of Education of China (2017) standards for vocational education program teaching, early childhood lesson design is a core course in the early childhood education major. The course content and requirements are specified as follows: students should be familiar with the processes and methods of lesson design in the five key areas of early childhood education. They should master the basic theories of early childhood educational lesson design. Students should be capable of formulating educational lesson goals for kindergartens, selecting appropriate content and methods, and be able to effectively organize and implement early childhood lessons. Additionally, students should be able to assess early childhood educational lessons. Therefore, lesson design ability is the central goal of the early childhood lesson design course.

2.2. Lesson Design Ability

Lesson design ability is the core capability of teachers to design, implement, and evaluate teaching activities based on teaching objectives, student needs, and teaching resources. It typically involves two key components: Pedagogical Content Knowledge (PCK) and lesson design skills. PCK provides teachers with the necessary subject knowledge and pedagogical guidance, while lesson design skills ensure that teachers can transform this theoretical knowledge into specific teaching activities and practices (Ball & Cohen, 1999).

PCK (Pedagogical Content Knowledge) is a fundamental base for lesson design ability. It encompasses three key areas: Teaching content knowledge, knowledge of learners, and teaching method knowledge. Teaching content knowledge refers to a teacher's understanding of the content they teach, while knowledge of learners involves understanding students' cognitive development and needs. Teaching method knowledge refers to the methods and strategies teachers use to convey content effectively. In early childhood education, PCK helps teachers understand children's learning needs and select and design appropriate teaching content based on these needs. Teachers not only need to master subject knowledge but also need to design suitable teaching strategies and activities according to students' learning levels and interests (Shulman, 1986).

Lesson design skills refer to teachers' ability to convert PCK into concrete teaching practices. These skills include learner analysis, goal setting, teaching resource preparation, lesson implementation planning, and teaching reflection (Pea, 1993).

PCK and lesson design skills complement each other, together forming a teacher's overall lesson design ability. PCK provides the theoretical foundation of subject content and pedagogical methods, while lesson design skills ensure that this knowledge and these methods can be effectively applied in real teaching contexts.

Effective strategies for improving lesson design ability include microteaching, case analysis, and simulation teaching. Microteaching involves short teaching activities that allow students to reflect and adjust their design. Case analysis helps teachers identify strengths and weaknesses in lesson designs and make improvements. Simulation teaching provides students with the opportunity to apply lesson designs in practice, make adjustments, and enhance their skills (Xu, 2009; Xie & Wu, 2019). These methods, by providing practical opportunities, feedback mechanisms, and reflection spaces, help students continuously optimize their lesson design and improve their application ability in actual teaching.

2.3. Meaningful Learning Theory

Carl Rogers, a key figure in humanistic psychology, developed Meaningful Learning Theory, also known as the Learner-Centered Theory, based on his client-centered therapy approach. He believed that only through self-exploration and self-directed learning can true behavioral change occur (Rogers, 1961).

Rogers distinguished between cognitive learning and experiential learning, asserting that cognitive learning is mechanical and lacks meaning, whereas experiential learning integrates learners' personal growth with learning experiences. This process organically connects learning with learners' interests, needs, and emotions, thereby fostering intrinsic motivation for learning (Rogers, 1983). He further emphasized that learning is not merely the reception of information but is constructed based on individual experiences. When learning content is connected to personal experiences, it becomes truly meaningful (Kolb, 1984).

The core principles of Rogers' Meaningful Learning Theory include learner-centered learning, experiential learning, the role of emotions in learning, self-directed learning, and self-actualization. He emphasized that teachers should act as facilitators rather than authoritative knowledge providers, creating a safe and open learning environment that encourages students to explore, reflect, and construct knowledge autonomously (Rogers, 1983). He also advocated for learning experiences that closely relate to real-life situations to enhance knowledge application and skill acquisition, and he stressed the importance of individualized learning paths that respect each student's unique learning needs (Knowles, 1975).

In educational practice, Rogers' theory has been widely applied in Project-Based Learning (PBL), Inquiry-Based Learning (IBL), and case-based teaching, all of which encourage learners to engage in knowledge construction based on personal experiences. Additionally, he emphasized the importance of a supportive learning environment that reduces anxiety and increases motivation, thereby promoting deeper learning (Maslow, 1970).

In early childhood pre-service teacher training, Meaningful Learning Theory can be effectively integrated to enhance lesson design ability. Traditional teaching models focus primarily on knowledge transmission, offering students limited opportunities to engage in the full instructional design process. As a result, future teachers may lack autonomy, creativity, and practical experience. By adopting Rogers' principles, instructional models can guide students in constructing lesson plans in authentic teaching contexts, improving their understanding of lesson design. Approaches such as

case analysis, microteaching, and contextualized learning allow students to apply their lesson designs in real or simulated early childhood education settings, fostering self-directed learning and reflective thinking (Xie & Wu, 2019).

In conclusion, Rogers' Meaningful Learning Theory emphasizes learner autonomy, experience-based learning, emotions, and self-actualization, profoundly influencing modern education. This theory provides a framework for developing innovative instructional models in early childhood teacher education, promoting self-exploration, practical application, and reflective optimization to strengthen future educators' lesson design competencies.

2.4. Related Theories

This study constructs an instructional model based on Meaningful Learning Theory to enhance the lesson design ability of pre-service early childhood teachers. In addition to Meaningful Learning Theory, Self-Determination Theory (SDT), Self-Efficacy Theory, and Experiential Learning Theory provide important theoretical support in areas such as teacher training, learning motivation, and skill development.

1) Self-Determination Theory (SDT)

Self-Determination Theory (SDT), proposed by Deci and Ryan (1985), emphasizes that intrinsic motivation is the core driver of learning and growth. This theory states that when learners' autonomy, competence, and relatedness are fulfilled, they exhibit the highest levels of motivation and achieve the best learning outcomes (Ryan & Deci, 2000).

In the educational field, SDT has been widely applied to enhance student motivation and engagement. Research indicates that when teachers provide greater autonomy support (e.g., allowing students to make learning choices, reducing external control, and encouraging active participation), students' intrinsic motivation significantly increases, leading to better academic performance (Reeve, 2006). Furthermore, competence support (e.g., providing positive feedback and designing challenging yet achievable tasks) enhances students' confidence, improving their classroom performance and academic success (Vallerand, 1997). Relatedness, or the sense of belonging, also plays a crucial role in learning motivation. When students feel socially supported by teachers and peers, they are more engaged and maintain long-term interest in learning (Jang, Reeve, & Deci, 2010).

In the training of pre-service early childhood teachers, SDT emphasizes the development of autonomy and professional competence. If future teachers experience decision-making, successful teaching, and emotional connections during their training, they are more likely to develop long-term motivation and foster children's learning interest in their future classrooms.

2) Self-Efficacy Theory

Self-Efficacy Theory, introduced by Bandura (1997), refers to an individual's belief in their ability to successfully complete a task. Higher self-efficacy leads to greater engagement in learning, a willingness to take on challenges, and perseverance in the face of difficulties (Zimmerman & Schunk, 2011).

In learning environments, students with high self-efficacy are more likely to employ effective learning strategies, explore concepts deeply, and adapt their strategies when facing challenges (Pintrich & De Groot, 1990). Research shows that teachers' self-efficacy directly impacts their teaching behaviors and classroom management abilities. Teachers with high self-efficacy tend to be more innovative and persistent in their teaching practices (Usher & Pajares, 2008).

To enhance pre-service early childhood teachers' lesson design ability, their self-efficacy must be strengthened through the following strategies:

Providing successful experiences: Engaging students in authentic teaching practices or simulated classrooms to help them experience success and build confidence (Bandura, 1997).

Observational learning: Watching skilled teachers demonstrate effective teaching strategies to reinforce belief in their own abilities (Bandura, 2001).

Positive feedback: Receiving encouragement and constructive feedback from teachers, peers, and mentors to boost self-efficacy (Schunk, 1991).

Self-reflection: Encouraging students to reflect on their teaching experiences to improve their lesson design strategies (Zimmerman, 2000).

Enhancing self-efficacy in pre-service early childhood teachers allows them to confidently apply lesson design principles, improve teaching quality, and remain motivated for continuous professional growth.

3) Experiential Learning Theory

Experiential Learning Theory, proposed by Kolb (1984), describes learning as a cyclical process consisting of four stages: Concrete Experience, Reflective Observation, Abstract Conceptualization, and Active Experimentation.

The core principle of experiential learning is “learning by doing”, meaning that learners acquire knowledge through hands-on experience rather than passive theoretical instruction. This theory has been extensively applied in teacher education, vocational training, and adult education, making it highly relevant for lesson design ability development (Kolb, 1984).

In pre-service early childhood teacher training, Experiential Learning Theory highlights:

Practice-driven learning: Using microteaching, situational simulations, and case analyses to immerse students in real teaching experiences (Schön, 1983).

Reflective learning: Encouraging students to analyze and refine their lesson designs after teaching activities (Boud, 1985).

Authentic teaching contexts: Integrating pre-service teachers into real kindergarten environments to enhance their lesson design adaptability (Dewey, 1938).

Applying experiential learning strategies allows pre-service teachers to develop lesson design ability through practical application, decision-making, and iterative improvement, ensuring higher teaching effectiveness.

4) Application of Related Theories in Instructional Model Development

In the instructional model based on Meaningful Learning Theory, SDT, Self-Efficacy Theory, and Experiential Learning Theory complement each other to enhance pre-service early childhood teachers' lesson design ability.

Self-Determination Theory fosters pre-service teachers' autonomy, competence, and relatedness, increasing their intrinsic motivation for lesson design.

Self-Efficacy Theory strengthens teachers' confidence in their teaching abilities, encouraging them to experiment with and refine lesson designs.

Experiential Learning Theory provides a practice-reflection cycle, allowing teachers to apply, evaluate, and optimize their instructional approaches in real classroom settings.

By integrating these theories, this study aims to develop an instructional model that is learner-centered, experience-driven, and focused on enhancing motivation and confidence, ultimately preparing pre-service teachers to design and implement effective early childhood education lessons.

2.5. Components of Instructional Models

According to Joyce, Weil, and Calhoun's Models of Teaching(2008), the well-designated model should qualify in six areas. The first component, called "Focus,"refers to the core intent of the model.The main objective of the model revolves around the focal components. The second one, called "Syntax," explains the composition of the model and contains the sequence of processes engaged in the model's organization.Each model can obviously have quite different syntax. The third component, called "Principles of Reaction," allows the instructor to observe the students and to react to the students ' performance over the model's application. The fourth one, called "Social System," represents the interactions between the teacher and students as each model is considered as if it were a small community. The fifth component is called "Support system". The assisting requirements are necessary to carry out the model favorably. And, the sixth component is called "Application". As an advantage of the model, it can be applied to other contexts. In this study, the six components presented by Joyce et al. (2011) were adapted in developing the instructional model namely (1) principles of the model, (2) objectives, (3) syntax, (4) social system, (5) principle of reaction, and (6) support system.

2.6. Conceptual Framework

Based on the review of literature and related theories, this study constructs a conceptual framework to guide the development of an instructional model that enhances the lesson design ability of early childhood pre-service teachers.

The framework is primarily grounded in Rogers' Meaningful Learning Theory, and is supported by Self-Determination Theory, Self-Efficacy Theory, and Experiential Learning Theory. These theories collectively inform the design principles, learning strategies, and implementation processes of the instructional model.

The model targets two main outcomes:

- (1) Development of Pedagogical Content Knowledge (PCK)
- (2) Enhancement of Lesson Design Skills

The framework of this study is shown in Figure 1:

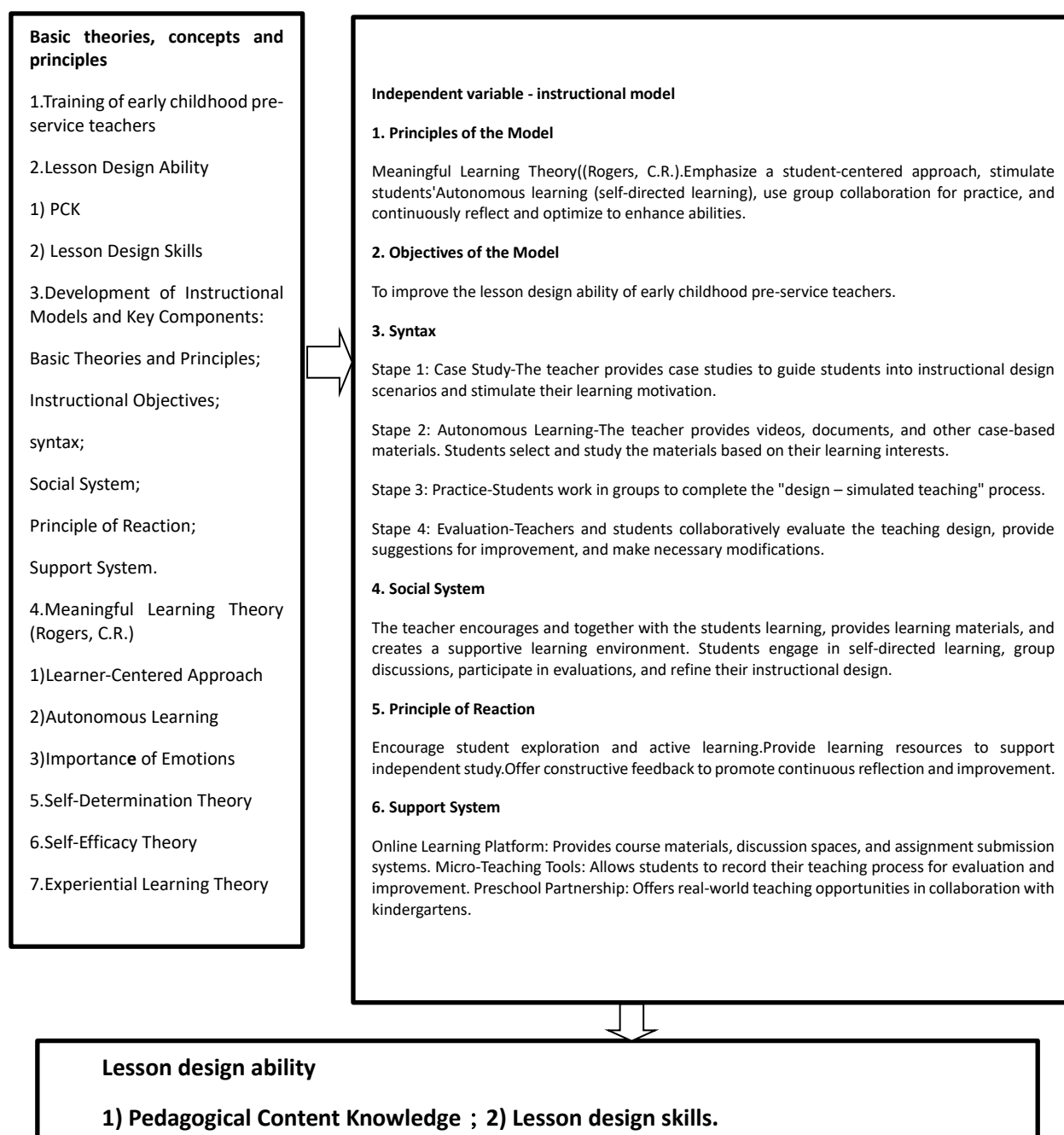


Figure 1. Conceptual framework for developing an instructional model based on meaningful learning theory to promote the lesson design ability of early childhood pre-service teachers

3. Methodology

3.1. Research Design

This study adopted a research and development (R&D) approach, which is commonly used in educational research to develop, validate, and refine instructional models through systematic procedures (Borg & Gall, 1989). The R&D process comprising three cyclical phases: Analysis (Needs assessment and theoretical grounding); Design (Model development and expert validation); Evaluation (Quasi-experimental implementation).

The research was conducted with students majoring in early childhood education at a preschool normal college. The implementation took place during the second semester of 2024, ensuring that the participants had sufficient prior coursework to engage meaningfully with the instructional model.

In this study, the independent variable was the newly developed instructional model based on Rogers' theory of meaningful learning. The dependent variable was the improvement of students' lesson design abilities, including both Pedagogical Content Knowledge (PCK) and lesson design skills (e.g., learner analysis, goal setting, content selection, evaluation and reflection).

This design allowed the researchers to observe changes in participants' competencies before and after the application of the model, thereby assessing its effectiveness. The methodology emphasizes practical application in real educational settings, aligning with the goal of producing a usable and meaningful instructional model for early childhood teacher education.

3.2. Data Collection

There are 3 phases in this study which can be described below:

In Phase 1, the basic information and needs for the development of the instructional model were examined to show the present condition of learning lesson design. The researcher reviewed, analyzed and synthesized the Roger's Meaningful Learning Theory and Self-Determination Theory, Self-Efficacy Theory, Experiential Learning, Curriculum standards, Lesson Design Ability, Current Teaching Practices and Strategies for Developing Lesson Design Ability as a guidance to develop the instructional model. In addition, the researchers used a random sampling method to randomly select 300 students from 1,635 students majoring in early childhood education at Xichang Nationalities Preschool Normal College and used purposive sampling to select five instructors who had at least five years of teaching experience in lesson design courses. Five experts in early childhood education, educational management, and statistics were invited to evaluate the research instruments, which included a 14-item questionnaire for assessing students' current status and needs in lesson design ability, and a 10-item interview guide for exploring teachers' instructional needs. The tools were reviewed for validity using the Index of Item-Objective Congruence (IOC), with all items receiving an IOC score of 1.0, and the questionnaire showed high reliability with a Cronbach's Alpha of 0.875.

In Phase 2, the model development was structured in two key steps: drafting the model and evaluating it through expert feedback. The researcher adopted a criterion of having at least five years of teaching experience in early childhood lesson design courses. Accordingly, five teachers who met this standard (with teaching experience ranging from 5 to 20 years) participated in a focus group discussion to collaboratively draft the model elements. These participants had diverse teaching backgrounds across language, art, health, social, and science education in early childhood lesson design courses. Meanwhile, the five experts involved in the evaluation included university professors and associate professors specializing in preschool education, curriculum and instruction, and educational psychology. All experts possessed over 10 years of relevant teaching or research experience. To ensure the quality of the evaluation tools, the researcher followed a rigorous process that included a literature review, preliminary tool development, expert consultation, and revision. The final evaluation form included both quantitative Likert-scale items and qualitative open-ended questions. Each expert rated the instructional model on a 5-point scale across multiple dimensions (e.g., instructional objectives, teaching strategies, syntax, social system, and support). Data were analyzed using descriptive statistics, specifically mean and standard deviation, to determine the usability level of the model. Mean score interpretation followed a standardized scale, where scores between 4.1 and 5.0 indicated the model was "Highly Usable." The findings from this phase showed that the model was rated as highly usable ($M > 4.4$, $SD < 0.6$) by all five experts, and their qualitative feedback was used to revise and finalize the CAPE model. This phase thus successfully bridged theory

and practice, ensuring that the developed model is not only theoretically sound but also practical and applicable in real teaching contexts.

In Phase 3, the implementation and evaluation of the instructional model (CAPE Model) were conducted using a quasi-experimental research design to assess its effectiveness in improving the lesson design ability of early childhood pre-service teachers. This phase involved two primary steps: classroom implementation and comparative effectiveness analysis through pre- and post-testing.

Two intact classes of second-year early childhood education students ($N = 60$) from Xichang Minzu Preschool Normal College were selected using cluster random sampling. One class ($n = 30$) served as the experimental group, receiving instruction based on the CAPE model, while the other ($n = 30$) served as the control group, receiving traditional instruction. A pre-test confirmed no significant differences in baseline lesson design ability between the two groups ($p > 0.05$), ensuring internal validity.

The instructional intervention for the experimental group was delivered over 36 hours and followed the CAPE Model's four-stage process: Case Analysis, Autonomous Learning, Practice, and Evaluation. The control group followed the conventional teaching syllabus without model-based enhancements.

To measure learning outcomes, a Lesson Design Ability Test (LDA-T) was developed by the researcher, grounded in a comprehensive review of the literature and validated by five domain experts in early childhood education, curriculum design, and educational assessment. The LDA-T assessed two key dimensions: Pedagogical Content Knowledge (PCK), covering knowledge of teaching content, learner characteristics, and instructional methods. Lesson Design Skills (LDS): covering six sub-skills including learner analysis, objective setting, activity preparation, content selection, implementation planning, and evaluation & reflection. The test consisted of 18 items in multiple formats (multiple choice, case analysis, and short-answer) and was reviewed for content validity using the Index of Item-Objective Congruence (IOC). IOC scores for all items ranged from 0.80 to 1.00, indicating high alignment between items and their intended constructs.

Additionally, a teaching syllabus based on the CAPE model was evaluated by five subject-matter experts. They assessed each section on a 5-point scale. Mean scores of the expert evaluations exceeded 4.5, with standard deviations below 0.5, indicating high consensus and strong approval of the syllabus's quality and alignment with instructional goals.

Data analysis included descriptive statistics (mean, standard deviation) and inferential statistics using independent samples t-tests to examine the differences in lesson design ability between and within groups. The results demonstrated statistically significant improvements in the experimental group's overall LDA scores ($p < 0.05$), particularly in both PCK and LDS dimensions.

3.3. Data Analysis

Phase 1, Descriptive statistics (mean, percentage) were used to analyze questionnaire responses from 279 early childhood pre-service teachers regarding their lesson design abilities and needs. Thematic analysis was used to interpret open-ended questionnaire responses and interview data from five instructors, identifying key themes about teaching practices and professional development needs. Content analysis was applied to literature and curriculum standards to extract theoretical foundations and instructional gaps.

Phase 2, Descriptive statistics (mean, standard deviation) were calculated from expert ratings on the instructional model using a 5-point Likert scale. Content analysis of open-ended expert suggestions helped refine and finalize the CAPE model.

Phase 3, Independent samples t-tests were conducted to compare: Pre- and post-test scores of the experimental group. Post-test scores between experimental and control groups. The analysis evaluated improvements in Lesson Design Ability (LDA), including PCK and LDS. Descriptive statistics (mean, SD) were used to summarize expert evaluations of the CAPE-based teaching syllabus.

3.4. Research Phase

To improve the clarity and transparency of the research design, a flowchart (Figure 2) is provided below to visualize the entire research procedure across the three phases:

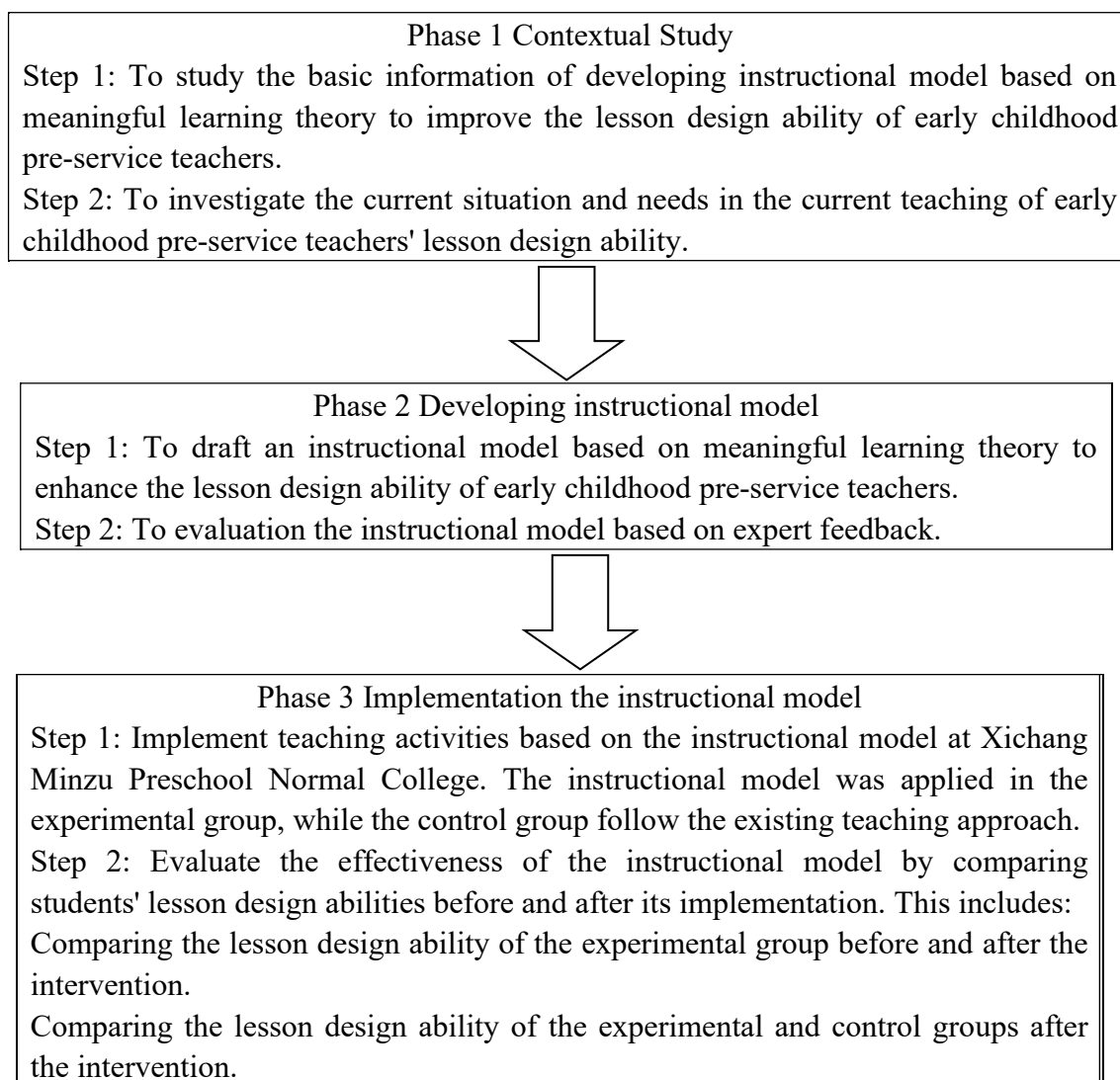


Figure 2. Research phase for developing instructional model based on meaningful learning theory to promote the lesson design ability of early childhood pre-service teachers

3.5. Ethical Considerations

Ethical approval for this study was obtained from the Research Ethics Committee of Xichang Minzu Preschool Normal College. All participants were informed about the nature and purpose of the study prior to data collection. The following ethical measures were taken:

Informed Consent: Participants signed a consent form indicating their voluntary agreement to participate. For student participants under 18, parental or institutional consent was obtained.

Confidentiality: All data were anonymized, and participants' personal information was kept confidential. Identifying details were removed during analysis and reporting.

Right to Withdraw: Participants were informed that they could withdraw from the study at any time without penalty or consequence.

Data Security: All collected data were stored securely in password-protected files and used solely for research purposes.

This ensured that the research adhered to international ethical standards for studies involving human participants.

4. Results

The findings of the study after the procedures of data collection, are examined regarding to the objectives of the study as follows:

4.1. To Study the Basic Information of the Development of an Instructional Model

The results of the study revealed that meaningful learning theory were employed to construct the model and develop the instruments.

Table 1. Results of early childhood pre-service teachers' lesson design ability self-evaluation

Lesson Design Ability Self-Evaluation	$\bar{x}$	S.D.	level
1. I can design lesson activities considering childhood's developmental needs.	3.12	0.86	medium
2. I can determine lesson objectives considering holistic child development.	3.24	0.94	medium
3. I can creatively plan and organize lesson processes.	3.20	0.96	medium
4. I can design suitable activities, games, and interactions for childhood.	3.26	0.99	medium
5. I can evaluate and reflect on lesson effectiveness and make necessary adjustments.	3.22	0.98	medium
6. I can prepare teaching aids, multimedia, and other resources to support teaching.	3.48	1.02	medium
view	3.25		medium

From the table 1, the mean of lesson design ability is 3.25, which is at a medium level. The average scores of the six dimensions are 3.12, 3.24, 3.20, 3.26, 3.22, 3.48, all at a medium level. meaning most respondents believe they have a certain level of ability in lesson design but still have room for improvement. The average scores of the six dimensions are also at a "medium" level, suggesting that respondents generally have a moderate view of their lesson design abilities.

Overall, the evaluation of lesson design abilities is at a medium level. Although pre-service teachers perform well in lesson preparation, their skills in classroom implementation planning and learner analysis are weaker. These results suggest that teachers still need further development in key areas such as learner analysis, classroom goal setting, activity design, and evaluation and reflection.

In students' needs, regarding the need for skill enhancement, all six sub-skills were identified as areas in need of improvement by more than 73% of respondents. Notably, the strongest needs were expressed for improving "lesson implementation planning" (85.3%), "lesson content selection" (82.4%), and "lesson evaluation and reflection" (79.5%). This reflects a widespread and urgent desire

among students to enhance their professional competencies through more structured and systematic training. The analysis of preferred forms of instructional support reveals that students most hope to receive "lesson design or activity case studies" (78.9%), "guidance on lesson design and planning" (78.1%), and "opportunities for simulated teaching" (76.8%). This indicates a strong preference for practical, experience-based learning approaches that integrate theory and practice. Additionally, the high demand for learning "child psychology and educational theory" (76.5%) suggests that students recognize the importance of a solid theoretical foundation in effective teaching.

In summary, students face several challenges in developing their lesson design abilities, including a lack of high-quality case resources, insufficient practical experience, limited individualized guidance, and inadequate understanding of children's learning needs.

After interviewing five teachers for their needs for early childhood lesson design–related courses to further explore teaching challenges and instructional development needs. The results reveal a consistent concern: current teaching practices insufficiently support students in developing essential lesson design competencies. Instructors highlighted significant student weaknesses in self-directed learning, reflective thinking, and practical experience, all of which hinder the effective improvement of curriculum design abilities.

To address these gaps, instructors unanimously emphasized the need for a redesigned instructional model grounded in practical application, learner autonomy, and collaborative engagement.

Additionally, instructors proposed a series of supportive measures to complement the new model:

Building high-quality exemplar lesson libraries to serve as references for student work.

Improving formative assessment and feedback mechanisms to guide and monitor student progress;

Experimenting with blended learning approaches to enhance accessibility and flexibility in instruction.

These teacher recommendations align closely with the needs expressed by students and underscore the urgency of creating a more authentic, dynamic, and responsive instructional model.

4.2. To Develop the Instructional Model

Based on the findings in Phase 1, the instructional model was developed. Its components can be illustrated by Figure 2.

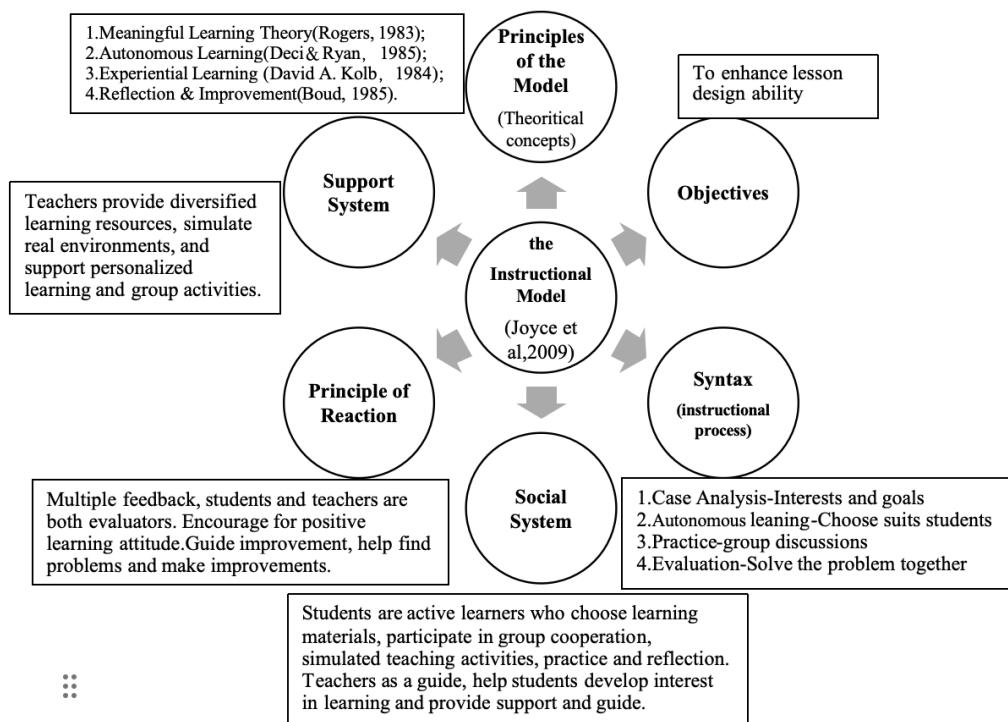


Figure 2. Draft of Instructional Model

Table 2. Expert's evaluational results of the instructional model

Instructional Model	item	Expert					mean	S.D	level
		1	2	3	4	5			
Principles of the model	1	5	5	4	5	4	4.6	0.55	Highly Usable
	2	5	4	4	5	4	4.4	0.55	
Objectives of the model	3	5	5	5	4	5	4.8	0.45	Highly Usable
	4	5	4	4	5	4	4.4	0.55	
Syntax	5	4	4	5	4	5	4.4	0.55	Highly Usable
	6	5	4	4	5	4	4.4	0.55	
Social System	7	5	5	4	5	4	4.6	0.55	Highly Usable
	8	5	4	4	5	4	4.4	0.55	
Principle of Reaction	9	4	4	5	4	5	4.4	0.55	Highly Usable
	10	5	4	4	5	4	4.4	0.55	
Support System	11	4	5	4	5	4	4.4	0.55	Highly Usable
	12	5	4	4	5	4	4.4	0.55	
view							4.47	0.54	Highly Usable

From Table 2, it can be seen that the experts' evaluation of the instructional model has an overall Mean = 4.47 (SD = 0.54), indicating that the instructional model is at a highly usable level. The ratings for Syntax (Mean = 4.4, SD = 0.55), Principle of Reaction (Mean = 4.4, SD = 0.55), and Support System

(Mean = 4.4, SD = 0.55). The experts also provided suggestions for improvement, and the model was revised and developed according to the experts' suggestions.

Therefore, the developed model consisted of 6 components: (1) Principles of the Model. Which consists of the following 4 concepts: Rogers' Meaningful Learning Theory: The Concept of Learner-Centered (Rogers, 1983); Autonomous Learning (Deci & Ryan, 1985); Experiential Learning (David A. Kolb, 1984); Reflection & Improvement (Boud, 1985). (2) Objectives of the Model: Improve the lesson design ability of early childhood pre-service teachers. (3) Syntax of the learning as shown in Figure 2: Stage 1: case analysis. Teachers and students jointly analyze the advantages and disadvantages of the case. Initially, perceive the learning standards and stimulate learning interest. Stage 2: autonomous learning. Students choose learning materials according to their interests, deeply study the theoretical framework and methods of teaching design, and build theoretical knowledge. Stage 3: practice. Through group cooperation to design courses and simulate teaching, constantly adjust and improve teaching design. Stage 4: evaluation. Through two-way feedback from teachers and students, and feedback between students. Timely identify and address deficiencies in teaching design, optimizing and adjusting as needed. (4) Social System: Students are active learners who choose learning materials according to their own level and interests; teachers as a guide, provide learning materials, resources, and tools to help students. (5) Principle of Reaction: Multiple feedback: Students evaluate each other, and teachers and students provide interactive feedback. Encouragement and affirmation: Teachers provide timely positive feedback to encourage students to maintain a positive learning attitude. Guidance and improvement: Through effective feedback, help students recognize their shortcomings, and provide optimized ideas and methods to encourage students to improve their teaching design. (6) Support System: Learning resources: Provide a variety of learning materials, such as teaching case texts, video materials, reference books, etc. Learning environment: Discussion room, Micro-teaching classroom, Simulated kindergarten training room. Teacher support: Teachers provide personalized learning guidance and provide targeted suggestions and feedback based on students' learning progress and needs.

According to the Syntax, the researchers called this instructional model the CAPE model. The model can be illustrated by Figure 3.

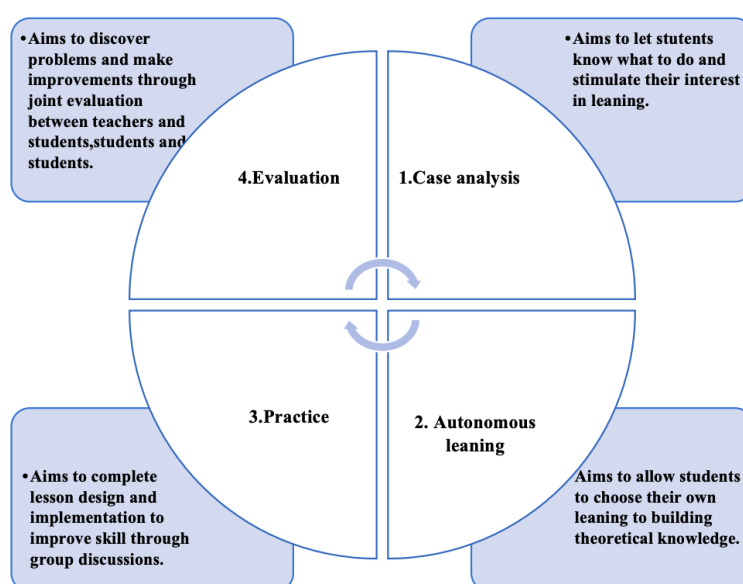


Figure 3. Syntax (Teaching process) in the CAPE Model

4.3. To Study the Results of Implementation of the Instructional Model

As mentioned earlier, the researcher conducted a pre-test for the experimental group (2201) and the control group (2202). The difference is not significant. The experimental group of the 2201 class, comprising 30 students, was taught under the new model, with a total of 36 hours of study. At the same time, the control group of 2202 class 30 students were taught under the traditional model, with a total of 36 hours of study. After a 36-hour instructional intervention, with 2 hours per week over a total of 18 weeks, the researcher conducted a post-test for the experimental group (2201) and the control group (2202), and they were analyzed by an independent samples T-test, as can be illustrated below.

Table 3. Pre-test and Post-test Scores of the Experimental Group (2201)

Dimensions	TEST	group	N	Mean	S.D.	df	P	t
PCK	Pre-test	Experimental	30	48.57	8.52	58	0.00000	-14.87
	post-test	Experimental	30	75.40	4.41			
LDS	Pre-test	Experimental	30	51.43	4.45	58	0.00000	-27.84
	post-test	Experimental	30	89.13	4.74			
LDA (Sum)	Pre-test	Experimental	30	100.00	9.27	58	0.00000	-27.01
	post-test	Experimental	30	164.53	6.75			

From Table 3, it is evident that the experimental group showed significant improvement in their lesson design ability before and after the teaching intervention.

For Lesson Design Ability (LDA), the experimental group's pre-test mean was 51.43, which increased to 89.13 in the post-test, with the standard deviation remaining stable. The $t = -27.84$, $P = 0.00000$, indicating a significant improvement in instructional design ability for both groups.

For the PCK dimension, the experimental group had a pre-test mean = 48.57, which increased to 75.40 in the post-test, while the standard deviation decreased from 8.52 to 4.41. The $t = -14.87$, $P = 0.00000$, demonstrating a significant difference.

For LDS (Lesson Design Skills), the experimental group's pre-test mean = 51.43, which increased to 89.13, with the standard deviation remaining stable. $t = -27.84$, and the $P = 0.00000$, indicating a statistically significant improvement.

PCK and LDS dimensions in the experimental group showed significant improvements in the post-test, $P < 0.05$, indicating that the teaching intervention had a significant impact on the students' ability development.

Table 4. Post-test of the Experimental and Control Groups

Post-test	Group	class	N	Mean	S.D	t	P
PCK	Experimental	2201	30	75.40	4.41	3.73	0.00048
	Control	2202	30	71.77	3.01		
LDS	Experimental	2201	30	89.13	4.74	2.40	0.020
	Control	2202	30	85.73	6.16		
LDA (sum)	Experimental	2201	30	164.53	6.75	4.04	0.00016
	Control	2202	30	157.50	6.74		

From the table 4, it can be seen that the Lesson Design Ability Test results of the experimental group ($M = 164.53$, $SD = 6.75$) were significantly higher than those of the control group ($M = 157.50$, $SD = 6.74$), with $T = 4.04$, $P = 0.00016 < 0.05$, indicating a significant improvement in the experimental group's lesson design ability.

For the PCK dimension, the experimental group ($M = 75.40$, $SD = 4.41$) was significantly higher than the control group ($M = 71.77$, $SD = 3.01$), with $T = 3.73$ and $P = 0.00048 < 0.05$, demonstrating a significant improvement in pedagogical content knowledge.

For the LDS dimension, the experimental group ($M = 89.13$, $SD = 4.74$) was significantly higher than the control group ($M = 85.73$, $SD = 6.16$), with $T = 2.40$ and $P = 0.020 < 0.05$, indicating a significant improvement in teaching design skills.

The results indicate that the CAPE Model has a significant positive impact on enhancing the lesson design abilities of early childhood pre-service teachers. The findings validate the effectiveness of the instructional model based on meaningful learning theory, demonstrating substantial improvements in pre-service teachers' Pedagogical Content Knowledge (PCK) and Lesson Design Skill(LDS). Compared to traditional teaching methods, the CAPE Model is more effective in improving lesson design abilities and better preparing pre-service teachers for their future roles in early childhood education.

5. Discussion

This study adopted a systematic R&D approach across three phases to develop, refine, and validate the CAPE instructional model aimed at enhancing early childhood pre-service teachers' lesson design ability. While the methodology and results have been previously described, this discussion section will go beyond reiterating findings to interpret them in light of existing literature, highlight the model's contributions to the field, and suggest implications for practice and future research.

The first phase of the study revealed that Rogers'(1983) Meaningful Learning Theory offers a pedagogically rich foundation for designing instructional interventions in teacher education. Its emphasis on learner-centeredness, autonomy, emotional relevance, and experience-based learning is consistent with recent calls in the literature for reforming teacher education programs to prioritize student engagement and authentic learning experiences (Darling-Hammond & Bransford, 2005; Elwood & Jordan, 2022). The needs analysis conducted during this phase highlighted a significant gap between policy and practice. While teacher education standards in China emphasize competencies in both PCK and instructional design, the actual teaching models in use are often theoretical,

fragmented, and insufficiently practical. Similar findings have been reported in related studies, where pre-service teachers struggle with transferring theoretical knowledge into effective classroom practices (Chen, 2013; Qiao, 2019). Moreover, students' moderate ability in lesson preparation but limited competence in lesson implementation and learner analysis aligns with earlier findings (Zhang, 2022; Shi, 2022). This confirms the need for models that provide repeated practice, simulation, feedback, and reflection to promote skill development. Thus, this phase contributes not only empirical evidence but also conceptual clarity to the discourse on lesson design ability, refining its structure into two major domains—PCK and LDS—and emphasizing its developmental nature.

The phase 2, The CAPE model—consisting of Case Analysis, Autonomous Learning, Practice, and Evaluation—was constructed based on an integration of Rogers' Meaningful Learning Theory and complementary frameworks including Kolb's Experiential Learning Cycle (1984), Deci & Ryan's Self-Determination Theory (1985), and Boud's (1985) reflection theory. This cross-theoretical integration strengthens the model's pedagogical credibility while also addressing calls in the literature for instructional approaches that foster self-regulated learning and reflective practice (Hardré, 2005; Diana et al., 2020). The design of the CAPE model is consistent with effective instructional models identified in prior research. For instance, its syntax parallels the "double-chain cycle" model proposed by Meng and Wang (2023) and the DTAIL model introduced by Elwood and Jordan (2022), which emphasize a combination of active engagement, feedback, and iterative refinement. However, CAPE distinguishes itself by embedding emotional and motivational elements throughout its four stages, particularly in its alignment with Rogers' and Deci & Ryan's principles. Expert validation of the model further confirmed its theoretical and practical value. High scores across all components underscore its clarity, feasibility, and relevance to pre-service teacher development. Experts' suggestions—such as integrating digital tools—echo broader trends in education, emphasizing technology integration (Lee & Griffin, 2021).

In phase 3, the quasi-experimental results provide strong empirical support for the effectiveness of the CAPE model. Significant improvements in the experimental group's post-test scores across all dimensions (PCK, LDS, and total LDA) are consistent with studies advocating experiential and reflective teaching models (Darling-Hammond & Bransford, 2005; Bandura, 1997). The CAPE model's effectiveness is also attributable to its alignment with experiential learning cycles. Students progressed from observing real cases to practicing and reflecting on their instructional designs—a structure that allowed them to connect abstract pedagogical concepts to practical classroom application (Kolb, 1984). Moreover, the emphasis on peer and teacher feedback fostered self-efficacy, which is a critical predictor of teacher performance (Bandura, 1997). These findings echo those of previous models that advocate for authentic learning environments, such as project-based learning (Fazilla et al., 2023) and the Wiki-based collaborative lesson preparation platform (Chen, 2013). Yet CAPE offers a more holistic and emotionally responsive structure that resonates particularly well with early childhood teacher education, where empathy, sensitivity, and learner-centeredness are paramount.

6. Conclusion

6.1. Conclusion

This study aimed to develop, implement, and evaluate an instructional model based on Meaningful Learning Theory to improve the lesson design ability of early childhood pre-service teachers. The research addressed the following three questions:

(1) What is the basic information for developing an instructional model based on meaningful learning theory to improve the lesson design ability of early childhood pre-service teachers?

The contextual analysis revealed a clear need for an instructional model that bridges the gap between theoretical knowledge and practical application. Existing teaching practices were found to be overly theoretical, fragmented, and lacking in reflective and experiential learning opportunities. Both students and instructors expressed a strong demand for learner-centered, practical, and structured approaches. The findings highlighted particular weaknesses among pre-service teachers in learner analysis and lesson implementation planning, confirming the necessity of a more targeted instructional strategy.

(2) What are the components of the instructional model developed based on meaningful learning theory to improve the lesson design ability of early childhood pre-service teachers?

The study developed the CAPE instructional model, grounded in Rogers' Meaningful Learning Theory and supported by Self-Determination Theory (Deci & Ryan, 1985), Experiential Learning Theory (Kolb, 1984), and Self-Efficacy Theory (Bandura, 1997). The model consists of six components: Principles of the model, Instructional objectives, Syntax (teaching procedures), Social system, Principle of reaction, and Support system.

These components are operationalized through four instructional phases—Case Analysis, Autonomous Learning, Practice, and Evaluation—that collectively enhance both Pedagogical Content Knowledge (PCK) and Lesson Design Skills (LDS). The model is learner-centered, reflective, and experience-driven, with mechanisms for feedback, collaboration, and simulation.

(3) What are the results of implementing the developed instructional model based on meaningful learning theory to improve early childhood pre-service teachers' lesson design ability in a normal college?

The quasi-experimental implementation confirmed the model's effectiveness. Students in the experimental group showed statistically significant improvements in all dimensions of lesson design ability—PCK, LDS, and overall LDA—compared to the control group. The CAPE model was found to significantly enhance students' abilities to analyze learners, set instructional goals, prepare materials, design content, plan implementation, and conduct evaluation and reflection. These findings affirm that the model is not only theoretically robust but also practically feasible and impactful in the context of pre-service teacher education.

In summary, the CAPE instructional model provides a structured and effective pathway for developing the lesson design ability of early childhood pre-service teachers. Its foundation in established learning theories and its integration of reflective, experiential, and learner-centered practices make it a valuable contribution to the field of teacher education. It can serve as a practical reference for teacher training institutions seeking to bridge the theory–practice gap and cultivate essential competencies among future educators.

6.2. Limitations

Despite the promising findings, this study has several limitations:

Sampling Constraints: The quasi-experimental phase was conducted in a single, non-randomly selected normal college using purposive sampling. This limits the generalizability of the findings to other institutions or regions.

Measurement Tool Development: The tools used to assess lesson design ability were developed within this study and validated through expert review. However, they were not tested across diverse contexts or with probabilistic sampling, which may affect their external validity.

Duration of Implementation: The intervention was relatively short (36 hours), which may not fully capture long-term effects on teaching ability or sustainability of improvements.

Technological Integration: Although the CAPE model emphasizes learner-centered and reflective strategies, it has yet to be adapted to digital or hybrid teaching environments, which are increasingly common in teacher education.

7. Recommendations

This study recommends promoting the CAPE instructional model in preschool teacher education to systematically improve the lesson design ability of pre-service teachers. The recommendations are as follows:

(1) Before implementing this model, teachers should have a deep understanding of the basic concepts of the CAPE model, especially its principles, teaching processes and practical operation methods based on meaningful learning theory, and clarify the implementation details of the syntax(case analysis, independent learning, practice, and evaluation).

(2) Before formal teaching, teachers should clearly convey to students the learner roles, teaching objectives, course content, learning outputs and learning processes advocated by this model to help students clarify the learning path and enhance learning motivation.

(3) Educational institutions should provide students with complete teaching resources and support environments, including paper and digital learning materials (such as case videos, micro-classes, high-quality teaching plans, etc.), simulated teaching classrooms, teaching seminars, etc., to ensure the smooth implementation of the teaching process.

(4) For future research, it is recommended to conduct long-term follow-up research on this instructional model to continuously evaluate its profound impact on students' lesson design ability, teaching confidence, and teaching behavior. At the same time, the adaptability and promotion effect of the CAPE model in different educational contexts can be further explored.

Declarations

Conflicts of Interest. The authors declare no conflict of interest.

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