Experiential Learning Through Play and Science: Enhancing Science Process Skills in Early Childhood Teacher Students

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The Asian Conference on the Social Sciences 2024
Official Conference Proceeding

Abstract

This study looks into the efficacy of experiential learning through play and science activities in building scientific process skills among early childhood teacher students. The research uses a four-step experiential learning model:

1. Situations/Interpretations: Engaging in play-based and science discovery activities.
2. Reflection: Asking questions to analyze activity outcomes.
3. Conceptualization: Synthesizing and solidifying knowledge of scientific process skills.
4. Application: Integrating acquired knowledge into everyday life or modifying it through repeated practice.

Specifically designed activities targeted various process skills, including observation, classification, communication, drawing conclusions, and making predictions. The results revealed positive outcomes:

- Early childhood teacher students demonstrated a good level of knowledge and understanding of scientific process skills.
- Their scientific practical fluency achieved a satisfactory level.
- This experiential learning approach proved beneficial for educators, fostering scientific curiosity and equipping them to organize effective science activities for early childhood development.

This research emphasizes the potential of play-based and science activities in equipping future educators with the necessary skills to nurture scientific exploration and discovery in young children.

Keyword: Experiential Learning, Science Process Skills, Attitude Toward Activity Learning

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1. Introduction

1.1 How Important Are Science Process Skills for Early Childhood Learning?

Science process skills are crucial for early childhood learning as they lay the foundation for critical thinking, problem-solving, and understanding the world around them. These skills include observing, classifying, measuring, predicting, and experimenting, which help young children develop their cognitive abilities and scientific thinking. There are 4 reasons why science process skills are important 1) Science process skills encourage children to ask questions, make observations, and draw conclusions based on evidence. This promotes critical thinking and analytical skills, which are essential for all areas of learning. According to Padilla (n.d.), science process skills are fundamental for nurturing young learners' abilities to think critically and solve problems, 2) engaging in scientific activities helps children improve their cognitive functions such as memory, attention, and reasoning. Truglio (2020) emphasizes that early exposure to science helps children develop their cognitive abilities by engaging them in activities that require them to think, reason, and solve problems, 3) science process skills foster a sense of curiosity and exploration in children. They learn to explore their environment, ask questions, and seek answers through hands-on experiences. Walton Academy (n.d.) highlights the importance of science in early childhood education, stating that it encourages children to explore and understand the world around them, thereby promoting a lifelong love for learning, and 4) Early mastery of science process skills set the stage for future academic success. Children who develop these skills early are better prepared for more complex scientific concepts and methodologies in later years. In summary, science process skills are vital for early childhood learning as they support critical thinking, cognitive development, curiosity, and a strong foundation for future academic success. Encouraging these skills from a young age can significantly impact a child's educational journey and overall development.

1.2 Why Is It Necessary for Early Childhood Teachers to Understand and Apply Scientific Processes Skills?

In early childhood education, the role of the teacher in guiding children’s scientific inquiry is pivotal and multifaceted. A crucial aspect of this role is grounded in the teacher’s pedagogical science knowledge, which encompasses a deep understanding of scientific concepts relevant to the children’s explorations. Worth, K. (1999) emphasizes that while direct instruction of scientific concepts may not be suitable for young children, the structure of learning experiences and the teacher’s facilitation are guided by their grasp of fundamental scientific principles. Through thoughtful questioning, comments, and probes, teachers can direct children’s attention to essential scientific phenomena, such as the flow of water or the movement of snails. By aligning their guidance with children’s interests and natural curiosity, educators create rich learning environments that foster scientific inquiry and reflection. Worth’s insights underscore the importance of equipping early childhood educators with robust pedagogical science knowledge. This knowledge not only supports effective facilitation of scientific explorations but also enhances educators’ ability to scaffold children’s learning experiences in ways that promote meaningful engagement with scientific concepts. Ultimately, by integrating pedagogical science knowledge into their practice, teachers play a critical role in laying the foundation for children’s lifelong curiosity and understanding of the natural world. Moreover, integrating pedagogical science knowledge into their practice allows instructors to design activities that integrate various subjects and relate them to real-life experiences. This makes learning more meaningful and engaging for

children. Instructors with scientific process skills can teach children to think systematically through observation, questioning, experimenting, and analyzing results. This helps children develop critical thinking and logical reasoning skills. Therefore, early childhood instructors who understand and apply scientific process skills can create a rich, engaging, and successful learning environment.

1.3 Why Important Is Experiential Learning?

Experiential learning is an essential part of modern-day Learning and Development (L&D) strategies because it promotes active learning, which is an essential part of employee engagement in a remote work environment. Kolb Experiential Learning Theory, developed by David A. Kolb, is widely recognized and influential framework that describes how people learn through experience. Since learning is the primary process used to navigate life, people can use this process for all forms of learning, development, and change. Learning occurs in any setting and continues throughout life. The experiential learning process supports performance improvement, learning and development. David Kolb described the ideal process of learning in a four-step Experiential Learning Cycle: Experiencing – Reflecting – Thinking – Acting. (Experiential Learning Institute. n.d.) Educators know that a student learns more quickly and retains more information when the subject matter pertains to them personally, and doing makes learning extremely personal. As Sir Richard Branson says, *"You don't learn to walk by following rules. You learn by doing, and by falling over"* (Envision Experience. 2023). Experiential learning is important because it bridges the gap between theory and practice, enhances engagement, and fosters deeper understanding and retention of knowledge. According to the Experiential Learning Institute, this approach emphasizes active participation and reflection, which helps learners develop critical thinking, problem-solving skills, and the ability to apply knowledge in real-world contexts (Experiential Learning Institute, n.d.). Moreover, experiential learning can boost motivation and enthusiasm for learning. Envision Experience (2023) highlights that students who engage in hands-on activities are more likely to be invested in their education, leading to improved academic performance and personal growth. Additionally, Abington Friends School (2021) notes that this method cultivates essential life skills such as collaboration, communication, and adaptability, which are crucial for success in today's rapidly changing world. In summary, experiential learning is a powerful educational approach that not only enhances academic outcomes but also prepares individuals for the complexities of real-life challenges by fostering essential skills and encouraging active, meaningful learning experiences.

1.4 Why Important Is Learning Through Play and Science?

Discover the numerous benefits of play-based learning in early education and the important roles play in children's social, emotional, physical, and academic development. Play-based learning has numerous benefits. It has an important role in early childhood education. A play-based program understands the importance of play in a child's development. It is a child-centered, age-appropriate pedagogy that fosters creativity, social interaction, academic skills, and critical thinking skills. Play-based learning is an approach to education that offers students different types of playful activities and experiences in the classroom. It is an age-appropriate, child-centred approach that focuses on learning through purposeful play. Through play, children can develop their cognitive, social, emotional, and physical skills. Play-based learning is often used in early childhood education, but it can be implemented in all grade levels (My Teaching Cupboard. n.d.). Learning through science play is crucial for children's development for several reasons such as 1) Science play allows children to engage

directly with materials, phenomena, and experiments, fostering a deeper understanding of scientific concepts (Gelman & Brenneman, 2004), 2) Play-based learning encourages children to ask questions, make predictions, and explore the world around them, promoting curiosity and a desire to understand scientific principles (Gopnik et al., 2000), 3) Through science play, children learn to experiment, test hypotheses, and solve problems, developing critical thinking and analytical skills essential for scientific inquiry (Bullock, 2003), 4). Play encourages creativity by allowing children to imagine, invent, and explore new ideas, which are fundamental to scientific discovery and innovation. (Bergen, 2002), 5) Collaborative play in science activities promotes teamwork, communication, and negotiation skills, as well as resilience and perseverance when faced with challenges (Dewey, 1938), and 6). Early positive experiences with science play can cultivate a lasting interest in science and STEM fields, potentially influencing future academic and career choices (Bonawitz et al., 2011). In conclusion, learning through science play is crucial for children's development on multiple fronts. It not only engages their curiosity and motivation but also enhances critical thinking, problem-solving skills, and creativity. By providing hands-on experiences and encouraging exploration, science play fosters a deeper understanding of scientific concepts while promoting social and emotional growth. These early positive experiences lay a foundation for lifelong interest in science, preparing children to become curious, informed, and capable individuals in an increasingly scientific and technological world.

1.5 Statement of the Problem

Based on the reasons provided above the goals of this study were to answer the following questions "How did the process of experiential learning through play and science promote learning outcomes in knowledge, scientific process skills, and attitude toward activity learning of early childhood teacher students?" Thus, an attempt has been made through this study to find “Experiential Learning Through Play and Science to Enhancing Science Process Skills in Early Childhood Teacher Students”

2. Objectives of the Study

The objectives of this study are as follows:

1. To study and compare knowledge outcomes about scientific process skills in early childhood teacher students before and after experiential learning through play and science activities.
2. To study and compare scientific process skills in early childhood teacher students before and after experiential learning through play and science activities.
3. To study attitude towards after experiential learning through play and science activities in early childhood teacher students.

3. Significance of the Study

The significance of the study attempted to:

- It is a guideline for creating experiential learning through play and science activities, which will be used to organize science learning activities for early childhood teacher students. This will be useful for early childhood teacher students in developing scientific knowledge, scientific process skills, and the scientific mind. Including developing expertise and fluency in hands-on science process skills to be applied in organizing science learning experiences for early childhood children. It also encourages early childhood teacher students to be self-confident, creative, and have

the ability of creating information in the form of holistic thinking. Students have fun studying together, understand how to work as a team, understand their own roles, take leadership, be accountable, and have a positive attitude toward organizing science learning opportunities.

- It is important for university lecturers since they frequently conduct learning activities in the form of lectures or in which students demonstrate their knowledge in front of the class, which does not reflect on learning outcomes, using the example of experiential learning through play and science activities, construct learning activities that focus on students' learning through situations/interpretations, reflection, conceptualization, and application, students reflecting the results of self-learning to self-created knowledge. This study can be used as a framework for building competency-based learning guidelines for develop student in the twenty-first century.

4. Delimitations of the Study

The study was delimited to the investigation into 2 phases:

Phase 1: Developing and Assessing the Quality of Lessons Plan for Experiential Learning Using Play and Science Activities

1.1 Play and science activities are integrated with the experiential learning model concept (Kolb, 1984) to enhance learning scientific outcomes, science process skills and scientific mind. This combination of play activities and scientific exploration makes learning fun and engaging while promoting scientific understanding and thinking, which becomes more interesting and effective. It also fosters a deeper engagement with the material and encourages learners to participate actively and be curious.

The four steps of experiential learning using play and science activities are as follows.

Fig.1 Kolb's Cycle of Experiential Learning

1. Situations/Interpretations: Engaging in play-based and science discovery activities.
2. Reflection: Asking questions to analyze activity outcomes.
3. Conceptualization: Synthesizing and solidifying knowledge of scientific process skills.
4. Application: Integrating acquired knowledge into everyday life or modifying it through.

1.2 Four lessons plan of experiential learning using play and science activities are as follows 1) Have fun with observation and classification, 2) Choose correctly to measurement and using numbers, 3) Excited about space and communication, and 4) Predictions and data interpretation. This activity covers 8 basic science process skills including 1) observation, 2) classification, 3) measurement, 4) using number, 5) communication, 6) data interpretation, 7) space and space, space and time, and 8) prediction.

1.3 Four lessons plan of experiential learning using play and science activities passed 3 experts in early childhood science teaching or science education conducted a quality inspection, evaluating the appropriateness of organizing learning activities, timing, measurement and evaluation and media used in learning. Overall, experiential learning using play and science activities were of high quality. The activities were tryout by the early childhood teacher students who were not in the sample. The result of tryout show that students have understanding of and proficiency with the scientific process skills, perform activities fluently and students wish to resume learning in these activities.

Phase 2: Experiment Teaching While Following the Created Lesson Plans

2.1 Population and Sample Selection

The population for this study is 3rd years of early childhood teacher students from the Faculty of Education at Udon Thani Rajabhat University, Thailand in Semester 2, academic year 2023, with 2 classroom and 56 students. The sample group used in this research, it is a population group of 25 students, obtained from cluster random sampling.

2.2 Research Variables

The study included four variables:

2.2.1 The independent variable: Experiential learning through play and science activities
2.2.2 The dependent variable 1: Knowledge outcomes about scientific process skills
2.2.3 The dependent variable 2: Scientific process skills
2.2.4 The dependent variable 3: Attitude towards after learning activities

2.3 Research Contents

This activity covers 8 basic science process skills including 1) observation, 2) classification, 3) measurement, 4) using number, 5) communication, 6) data interpretation, 7) space and space, space and time, and 8) prediction.

2.4 Research Hypothesis

Based on the research questions, the following hypothesis was formulated:

1. Experiential learning through play and science for early childhood teacher students, there was a greater learning outcome in knowledge of scientific process after studying than before studying.
2. Experiential learning through play and science for early childhood teacher students, there was a greater learning scientific process skills after studying than before studying.
3. Early childhood teacher students gain experiential learning through play and science and have good attitude toward activity learning after their studies.

2.5 Research Time

In this study were experiment 6 weeks, 4 weeks for the instruction (use the time to experiment with instruction 1 lessons plan per week, 4 hours per plan, total time 16 hours),

and 2 weeks for the application of the pretest and the posttest. This study experiment in semester 2, academic year 2023.

5. Research Concept Framework

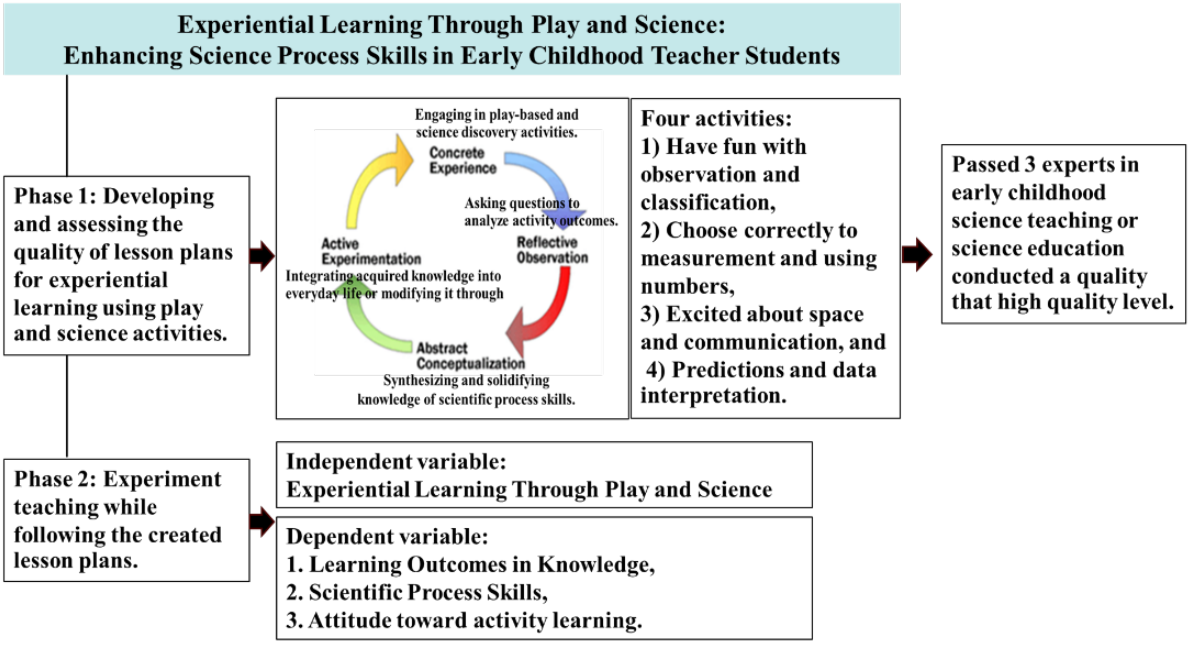

Fig.2 Research concept framework of Experiential Learning Through Play and Science: Enhancing Science Process Skills in Early Childhood Teacher Students

6. Research Methodology

6.1 Research Instrument

6.1.1 Instrument for Teaching Experiments

Four lesson plans on contents science process skill activities using the experiential learning through play and science uses a four-step experiential learning model concept (Kolb, 1984).

6.1.2 Instruments of Evaluation

1) An outcome in knowledge about scientific process skills test, the test is two – tier multiple – choice test included 16 multiple-choice
2) A scientific process skills test, the test is hands-on with 4 testing activities
3) An attitude toward activity learning questionnaire: the questionnaire is 5 levels rating scale according to the Likert method, asked about feelings and perceived benefits of learning activities.

6.2 Design of the Study

Research design used is one group pretest and posttest design.

Group	Pretest	Experimental	Posttest
E	O_1	X	O_2

E The sample group
O1 Pretest
X Using experiential learning through play and science
O2 Posttest

6.3 Conducting Experiments and Collecting Data

The researcher conducting experiments and collecting data of using experiential learning through play and science to a sample group as follow the steps:

1. The sample group applied scale of pretest of outcome in knowledge about scientific process skills, and scientific process skills in classroom research test.
2. The teacher was informed about the purpose of the study and using instruction based on experiential learning through play and science in classroom research, during the process teacher was observed, the interaction between teacher-students and students-students. The study instruments 6 weeks, 4 weeks for the instruction, 2 weeks for the application of the pretest and the posttest.
3. Applied scale of posttest outcome in knowledge about scientific process skills, scientific process skills that the test same pretest and give opinions in attitude towards learning activity questionnaire.
4. The pretest and posttest scores were used to analyze the statistical data to test the hypotheses further.

6.4 Data Analysis

Mean, percentage, and standard deviations of measured quantities was determined and t-test for dependent samples to compare a greater learning outcome in knowledge of scientific process and scientific process skills after studying than before studying and t-test for one sample that to test good attitude toward activity learning after studies done for hypothesis testing.

7. Findings

7.1 Outcomes Knowledge Outcomes About Scientific Process Skills

The comparison between pretest-posttest of learning outcomes in knowledge scientific process skills of early childhood teacher students by using experiential learning through play and science this can be summarized in table 1 as below.

Table 1: Data analysis results of outcomes in knowledge scientific process skills.

N	Test	Mean Score	S.D.	%	t-test	p
25	Pretest	14.24	2.788	29.67	28.119**	.000
	Posttest	36.44	3.216	75.92		

Note. **p<.01

According to table 1, the mean outcomes in knowledge scientific process skills pretest score obtained by early childhood teacher students was 14.24 (29.67%). After learning, their mean

posttest score is 36.44 (75.92%). This is a comparison to determine how there is improvement from pretest to posttest; the results reveal that the posttest mean score was higher than the pretest.

7.2 Scientific Process Skills

The comparison between pretest-posttest of scientific process skills of early childhood teacher students by using experiential learning through play and science this can be summarized in table 2 as below.

Table 2: Data analysis results of scientific process skills.

N	Test	Mean Score	S.D.	%	t-test	p
25	Pretest	7.96	1.274	33.17	27.070**	.000
	Posttest	18.56	1.609	77.36		

Note. **p<.01

According to table 2, the mean scientific process skills pretest score obtained by early childhood teacher students was 7.96 (33.17%). After learning, their mean posttest score is 18.56 (77.36%). This is a comparison to determine how there is improvement from pretest to posttest; the results reveal that the posttest mean score was higher than the pretest.

7.3 Attitude Toward Activity Learning

The comparison between posttest with specified criteria of attitude toward activity learning of early childhood teacher students by using experiential learning through play and science this can be summarized in table 3 as below.

Table 3: Data analysis results of attitude toward activity learning.

N	Attitude toward	Total	Mean	Criteria Standard	S.D.	%	t-test	p
25	feeling	5.00	4.18	4.00	0.329	83.68	60.60**	.000
	Perceived benefits	5.00	4.21	4.00	0.349	84.16	57.47**	.000
	overall	5.00	4.20	4.00	0.208	83.91	95.93**	.000

Note. **p<.01

According to table 3, the mean attitude toward activity learning after learning in feeling about activities mean score 4.18 (8368%), perceived benefits 4.21 (84.16%), and overall is 4.20 (83.91%). This is a comparison with criteria standard to determine feeling about activities and perceived benefits, the results reveal that in the feelings, perceived benefits and overall were at the “good” level after their studies.

8. Results Discussions

8.1 Outcomes in Knowledge About Scientific Process Skills and Scientific Process Skills

In this study experiential learning through play and science are 4 step experiential learning model adapted from Kolb’s cycle includes engaging in play-based and science discovery activities. In the first step, the instructor engaging students in play-based and science discovery activities, this stage will allow students to exercise their scientific process skills.

This activity has 4 activities are as follows 1) Have fun with observation and classification, 2) Choose correctly to measurement and using numbers, 3) Excited about space and communication, and 4) Predictions and data interpretation. This activity covers 8 basic science process skills including 1) observation, 2) classification, 3) measurement, 4) using number, 5) communication, 6) data interpretation, 7) space and space, space and time, and 8) prediction. This activity is for students to reflect on how the activities are related to their own scientific process skills. In step 2, students collaborated to evaluate, synthesize, or reflect on concepts from the activities they completed in step 1. How did students work on their scientific process skills? What are scientific process skills, and how significant are they? The instructor will be responsible for asking questions to allow students to express themselves as much as possible. In step 3, the instructor will ask students to summarize concepts learnt through concrete experience and reflection. Students will use discussion to build understanding and summarize shared concepts together as abstract conceptualization. In step 4, the instructor introduces new issues or situations to allow students to express their thoughts while using the principles and the previously taught concepts can be implemented in early childhood experiences, such as "Let students create science play activities to practice scientific process skills for early childhood children". Experiential learning through play and science has been shown to effectively increase students' understanding of scientific process skills. The interactive and engaging nature of these activities captures students' interest, making complex scientific concepts more accessible. For instance, students involved in hands-on experiments or scientific games are more likely to understand and remember the steps involved in the scientific process, such as formulating hypotheses, designing experiments, observing results, and drawing conclusions. A study by Hsiung et al. (2018) supports this, indicating that students who participated in experiential learning activities exhibited a better grasp of scientific process skills compared to those who only received traditional lecture-based instruction. The active involvement in scientific processes allows students to see the relevance and application of what they are learning, thereby deepening their comprehension. In addition to enhancing knowledge about scientific process skills, experiential learning through play and science directly improves the skills themselves. When students engage in scientific experiments and problem-solving games, they practice critical thinking, data collection, analysis, and interpretation. These practical experiences are crucial for developing proficiency in scientific methodologies. Johnson et al. (2020) found that game-based learning and interactive scientific activities significantly improved middle school students' scientific process skills. The study showed that students who regularly engaged in these activities developed better observational and analytical skills, enabling them to conduct experiments more effectively and draw more accurate conclusions. The repetitive practice of these skills in a playful and less stressful environment fosters a positive attitude towards learning science, which is essential for sustained educational success. The research highlights the substantial benefits of experiential learning through play and science in enhancing students' knowledge about scientific process skills and the skills themselves. These methods foster a deeper understanding and proficiency in scientific processes, making them invaluable tools in science education.

8.2 Attitude Toward the Experiential Learning Through Play and Science

The positive feelings students had about the experiential learning activities underscore the importance of engagement and enjoyment in the learning process. The interactive nature of play and science activities likely contributed to this favorable response. Activities that were hands-on and exploratory allowed students to actively participate and immerse themselves in the learning experience. This approach contrasts with traditional lecture-based methods,

which can be passive and less engaging. Students reported finding the activities enjoyable and interesting, which is crucial for maintaining motivation and enthusiasm for learning. Enjoyment in learning fosters a more positive attitude towards the subject matter, encouraging students to explore and understand scientific concepts more deeply. Students perceived several significant benefits from engaging in experiential learning through play and science. These perceived benefits include enhanced understanding of scientific concepts, improved scientific process skills, and increased confidence in conducting scientific inquiries. The hands-on nature of the activities provided practical experience that helped students grasp complex concepts more effectively than through theoretical instruction alone. Additionally, the collaborative aspect of many play-based learning activities promoted social interaction and teamwork, which are essential skills in scientific endeavors. Students recognized the value of working together, sharing ideas, and learning from each other, which are all integral components of the scientific process. The findings align with previous research by Hsiung et al. (2018) and Johnson et al. (2020), which also highlighted the benefits of experiential learning in enhancing students' scientific understanding and skills. The positive reception from students suggests that incorporating play and hands-on science activities into the curriculum can be a highly effective strategy for improving science education. The research demonstrates that experiential learning through play and science is well-received by students, with their feelings, perceived benefits, and overall experiences rated at a "good" level. These positive attitudes highlight the effectiveness of these methods in enhancing students' engagement, understanding, and skills in science. By incorporating more experiential learning activities into the curriculum, educators can create a more dynamic and effective science education environment.

Classroom reflections (Students' opinions on learning activities):

> *"I had so much fun looking for solutions that I forgot about the hour after class was over."*
>
> *"I would like teachers to plan activities like this. It was so much fun that I forgot about the time limit."*
>
> *"I enjoy this activity. It seems as if the teacher did not teach anything but I learned something and was quite pleased."*
>
> *"I understand why we need to participate in activities because it helps us understand ourselves and, more significantly, it teaches me how to design activities for early childhood children to learn while having fun. I will do my best."*

9. Conclusion

In conclusion, experiential learning through science play is a highly effective method for building knowledge and proficiency in scientific process skills among early childhood teacher students. This approach also enables these students to construct engaging and educational science activities for young children. By incorporating experiential learning into teacher education programs, educators can better prepare future teachers to create fun and effective science learning experiences for their students. The research highlights the importance of hands-on, play-based learning in early childhood science education and its potential to enhance both teaching and learning outcomes.

10. Recommendations

1. The findings suggest that incorporating experiential learning through play and science into the curriculum can lead to more effective science education. Teachers should consider integrating hands-on experiments, science games, and interactive projects into their lesson plans. By doing so, they can create a more engaging learning environment that not only enhances students' knowledge but also equips them with essential scientific skills.
2. The positive attitudes and perceived benefits reported by students have important implications for educators and curriculum designers. To leverage these advantages, schools and teachers should consider integrating more experiential learning activities into their science programs. Providing opportunities for students to engage in playful, hands-on learning can enhance their interest in science, improve their understanding of scientific concepts, and develop their scientific process skills.

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