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Implementation and Insights on Science Inquiry Activities in Kindergartens Under the Concept of STEM Education

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Abstract: The STEM education philosophy spans across disciplines such as science, technology, engineering, and mathematics. In the context of thematic activities in kindergartens, teachers can utilize the STEM education philosophy to cultivate children's innovative thinking qualities and practical operation skills, helping them develop a scientific inquiry spirit and skills. This paper takes the development of science inquiry activities in kindergartens as a path, exploring the significance and implementation paths of applying the STEM education philosophy in such activities.

Keywords: STEM education; Science inquiry; Thematic activities

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1. Introduction

In the "Guidelines for the Learning and Development of Children Aged 3–6," the core of the science domain is to stimulate children's desire for inquiry and enhance their scientific inquiry skills [1]. Children's innate curiosity and desire to explore provide the conditions for the cultivation of scientific inquiry skills. Focusing on scientific inquiry skills and using the spirit of science inquiry to solve problems encountered in actual life or learning processes is an extension of science inquiry activities in practice. STEM education emphasizes the effective combination of fields such as science, technology, engineering, and mathematics, starting from solving practical problems, focusing on cultivating children's interdisciplinary thinking and comprehensive problem-solving skills, and emphasizing hands-on practice and the spirit of inquiry [2]. STEM education can offer new ideas for integrating science inquiry activities in kindergartens. This paper mainly explores the significance and implementation paths of science inquiry activities from the perspective of STEM education through the development of thematic activities in frontline teaching practice.

2. The significance of conducting science inquiry activities in kindergartens under the STEM education philosophy

Kindergarten thematic activities are a comprehensive learning method based on specific themes. By involving children in theme design, experience, practice, and operations, these activities guide children's cognition and understanding of the world. The characteristics of kindergarten thematic activities include having a core, a theme, continuity, and development. By presenting the sources of themes, objectives of thematic activities, creation of themed environments, and the clues for the development of thematic content during the activities, it can greatly meet children's interests and desires for learning and inquiry.

Children are inherently curious about the world around them, which determines the various possibilities for science inquiry activities to improve children's learning quality and literacy [3]. Science inquiry activities are a method for children to acquire knowledge and experience. During the development of science inquiry activities, children can gain knowledge and experience through personal experience, practical perception, and hands-on practice, further enhancing their ability to discover and solve problems. This also promotes the development of various abilities such as inquiry and innovation in children [4].

The STEM education philosophy places core scientific concepts in real-life problem situations [5], breaking away from traditional, singular interactive methods. It emphasizes the integration of knowledge from various disciplines driven by key issues in the problem-solving process, which aligns well with the idea of cultivating children's scientific inquiry skills through thematic activities. Under the guidance, support, and help of teachers, children engage in thematic learning around interesting real-life "themes" through inquiry-based, cooperative, and active learning. They comprehensively use knowledge from fields such as science, technology, engineering, and mathematics to solve meaningful problems, thus forming a series of new activity structures and laying a good foundation for the comprehensive development of children.

3. The practical implementation of science inquiry activities in kindergartens under the STEM education philosophy

The STEM education philosophy is not merely a simple combination of disciplines but a series of processes involving integration, reconstruction, and fusion unlocking. The development of science inquiry activities in kindergartens under STEM education needs to capture the core values of STEM education: (1) the integrated learning of cross-domain knowledge; and (2) the cultivation of children's independent inquiry and innovation abilities. In the specific development of thematic activities, teachers need to be guided by the STEM education philosophy, comprehensively carrying out activities through theme selection, theme environment creation, theme activity resource selection, and theme activity implementation.

3.1. Theme selection for science inquiry activities under STEM education philosophy

The selection of themes in thematic activities should come from things children see, hear, and experience in their daily lives and should be closely related to their life experiences and interests. Combining the STEM education philosophy, starting from solving practical problems, emphasizes collecting materials in life situations, and the learning context should be full of life and authenticity. Kindergarten STEM-themed activities should focus on children's lives, games, regional characteristics, and other aspects to select themes, digging for suitable activity projects from surrounding things and topics. This helps children develop emotions, accumulate experience, and enhance skills through active "doing" and "practicing."

For example, based on children's life experiences and interests, leveraging regional resources with aerospace elements, activities like "Space Station," "Children's Dream of Space," "Flying to Mysterious Outer

Space," and "Space Travel Diary" can be carried out. Additionally, combining opportunities such as seasons, solar terms, food education courses, and labor-themed education, activities like "Autumn Harvest and Winter Storage—The Season of Harvest," "Autumn Harvest and Winter Storage—Making Cured Meat," "Persimmon Cakes," "Pumpkin Cakes," "Sweet Double Ninth Cakes," "Wishing for Persimmon Prosperity," "Exploring Dumplings," and "Candied Hawthorn" can be conducted. These activities immerse children in traditional Chinese culture, helping them understand the busy farming seasons and experience the joy of labor. Moreover, according to children's interest points in insects and animals observed in daily activities, activities like "Jungle Adventure," "Exploring the World of Dinosaurs," "Interesting Insects," and "Insects, Insects Fly" can be generated as scientific inquiry-themed activities.

3.2. Creating the environment and selecting resources for science inquiry activities under STEM education philosophy

The environment is an important educational resource, and through its creation and utilization, children's development can be effectively promoted [6]. Before the thematic activities, creating an environment suitable for exploratory STEM-themed activities and fostering an atmosphere highlighting STEM concepts can stimulate children's interest in participation.

For instance, the "Autumn Harvest and Winter Storage—The Season of Harvest" STEM-themed activity revolves around "Knowing Autumn, Collecting Autumn, Appreciating Autumn, Painting Autumn, and Drying Autumn." This approach attempts to learn about nature's knowledge and experiences through personal experience, establishing a system of activities connecting with nature, farming, and science. It follows the natural rhythm changes and farming culture spirit contained in the 24 solar terms, observing the unique "harvest" changes in autumn, actively exploring the growth methods of crops and the drying methods of food. This allows children to experience that autumn is a poetic and beautiful season, appreciating the magical charm of nature, making the solar terms tangible and perceptible, and helping children better understand the relationship between humans and nature.

Before the thematic activities, teachers create thematic walls, enrich area activity materials, and set up "Autumn Harvest and Winter Storage" themed exhibitions to create an environment in classrooms, corridors, and public areas that presents an intuitive and perceptible autumn scene. Teachers guide children to explore autumn's secrets through surveys, experiencing autumn with their parents over weekends, discovering and recording autumn, and enriching thematic walls with their representations. Meanwhile, in the library area, books such as *Dancing Leaves*, *Little Wild Goose's Autumn*, and *The Taste of Autumn* are introduced to help children have a more intuitive perception and experience of autumn through reading. They also seek answers to questions like "fermentation" and "mold" generated during children's courses, leveraging the hidden educational value of the books in thematic activities. In the art area, abundant natural materials like leaves, branches, and pine cones are provided for children to engage in drawing, crafts, and other art activities, utilizing these materials for various forms of natural art education activities, embedding autumn into artworks. In the life area, combining solar term activities, labor education, and food education, children use materials like flour, yeast, bowls, water, various autumn vegetables and fruits, juicers, and kitchen tools to make seasonal autumn foods like "pumpkin cakes," "persimmon cakes," "colorful steamed buns," "candied hawthorn," and "pomegranate juice."

3.3. Exploring the implementation pathways of science inquiry activities under the STEM education philosophy

The implementation of thematic activities is a key step in the development of these activities. Play is the

primary method and approach [7], and cultivating inquiry skills is one of the important goals. In exploring the pathways for implementing science inquiry courses under the STEM education philosophy, teachers should start from the children's perspective, providing opportunities and spaces for them to perceive, experience, and operate in a gamified manner. This allows children to fully engage with the world around them and attempt to use their experiences to solve problems independently.

For example, in the STEM-themed activity "Children's Dream of Space" based on children's interests and regional aerospace resources, teachers help children accumulate preliminary experience through home-school interaction, teacher-child discussions, and environmental setup before the course implementation. The course implementation consists of stages such as the sprouting of the "aerospace dream," space exploration, rocket launch, space route map, and the design and construction of space. During the course, various questions that stimulate children to think and inquire are posed. Children engage in a series of inquiry-based activities, exploring the secrets of rocket launches using balloons, understanding the secret routes of rocket launches by creating route maps, building space capsules using classroom building materials, and inviting younger classmates to visit the space capsule they created through space invitations. In this themed activity, children learn to discover problems, explore issues, and solve problems using all available resources and their life experiences. This, to some extent, cultivates children's inquiry, cooperation, and innovation abilities.

Another example is the "Autumn Harvest and Winter Storage" themed series of activities conducted by teachers based on seasonal characteristics. In a collective activity "Where Do Winter Vegetables Come From?", children learn how vegetables were stored for winter consumption in times when transportation was inconvenient, and technology was underdeveloped. During the children's autonomous discussion session, they may be curious about how meat was stored in the past, the teacher can then initiate an inquiry-based generative activity "Curing Meat." This includes learning about food storage methods, exploring the process of making cured meat, preparing materials (such as star anise, pepper, cinnamon, salt, and cookware), making the cured meat (frying, applying seasoning), stringing it, outdoor drying, indoor drying (deciding where and how to hang it), seeking help, and successfully drying it. Throughout this series of inquiry activities, children think and learn actively, using their previously acquired experiences to solve encountered problems. Children learn social interaction and cooperative inquiry spirit during the activities.

In another class, during the "Autumn Drying" activity, children noticed different changes in the dried pumpkin after a few days—it had developed mold and smelled sour and unpleasant. Questions arose including "What is mold?", "Where does mold come from?", "Why does dried pumpkin get moldy?", "How should it be dried?", and "Can moldy food still be eaten?" The teacher, responding to the children's questions and curiosity, decided to find answers together with the children, leading to the generative activity "Exploring Mold." Through home-school interaction, data collection, making fermented bread, exploring beneficial bacteria, and other methods, they explored the "family of bacteria in life" together. Such continuous teacher-child and child-child interactions actively develop children's initiative, allowing them to construct knowledge independently based on their existing experiences, significantly enhancing their ability to think independently and solve practical problems.

4. Conclusion

Childhood is a peak period for the rapid formation and development of imagination and inquiry skills. Cultivating children's scientific inquiry skills and rich imagination is more important and urgent than ever [8]. The development of inquiry-themed courses under the STEM education philosophy centers on children's development from

beginning to end. Children actively participate in the challenging inquiry process, continuously exploring by combining their experiences. They discover life's mysteries, enjoy the fun of creation, gradually solve problems, and provide reasonable explanations. This approach emphasizes starting from the child's perspective, allowing them to explore and find solutions in their own way, thereby constructing a structured system for in-depth analysis and explanation of problems. Therefore, in organizing science inquiry teaching activities, teachers should value and respect children's subjectivity [9], providing them with enough time and space to help them become capable inquirers.

Disclosure statement

The author declares no conflict of interest.

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