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# *The Design and Implementation of Game Teaching in Scientific Education Activities*

**Wenqi Zhang**

*Taizhou University, Taizhou, China*
*Wenqi2864@gmail.com*

***Abstract.*** With the rapid development of science and technology, people's demand for talents with the ability of inquiry, logical reasoning, and innovation is increasing, and the pre-school training of children's scientific inquiry and logical thinking has also been widely concerned and valued by parents and teachers. In kindergartens, scientific education, as one of the five major areas of teaching activities, plays a crucial role in the cultivation of children's ability in this area, and can potentially affect children's attitude towards new things and exploration methods in future science. In kindergartens, there are still problems such as children's low interest and participation in scientific activities, the lack of interest and rationality in scientific activity design, and the lack of kindergarten attention. Combined with the game, the main and preferred learning way of preschool children. Based on this, this paper puts forward suggestions on the interaction between teachers and children, such as providing children's thinking time and appropriate feedback, and methods and focuses of game teaching.

***Keywords:*** Scientific Education Activities, Game Teaching, Kindergarten

## 1. Introduction

The "Law of the People's Republic of China on Preschool Education" states: "Kindergartens should take the daily life of preschool children as their foundation and use play as their primary activity." With the implementation of the Preschool Education Law, the methods of educating young children have gradually shifted toward gamified teaching. In science activity education in kindergartens, issues have emerged such as teachers frequently relying on multimedia teaching materials, insufficient quantities and varieties of game materials, a lack of structural organization, and unreasonable design. Despite extensive discussions on the design and strategies of gamified teaching, there remain challenges in science activity design and implementation, including a lack of gamification in teaching and game designs that do not align with children's age characteristics.

Regarding the design and experimentation of gamified teaching in science activities, numerous scholars both domestically and internationally have conducted research. In studies on the role of gamified science teaching, Lü Hui argues that teachers can use gamification to transform abstract scientific concepts into intuitive, hands-on game activities, guiding children to engage in scientific inquiry through direct perception, thereby enhancing their scientific literacy [1]. Kalogiannakis and

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other scholars share this view, asserting that gamification, as a scientific teaching tool, can stimulate children's enthusiasm and interest, attracting them to learn scientific knowledge through inquiry [2].

In the design of gamified science activities, Christopoulos et al. suggest that gamified activity design in the preschool stage should be discovery oriented [3]. Papadakis et al. propose that incorporating narrative stories and creating realistic game environments in gamified teaching activity design can enhance students' interest [4]. Yu Ying and other scholars maintain the view of creating an environment and propose that while enhancing students' interest, teachers should also pay attention to the challenge level of game tasks, which should have clear objectives, a certain degree of difficulty, and provide phased feedback to help students achieve a state of flow and gain a sense of self-efficacy [5]. Additionally, Luo suggests that in the design of gamified teaching, it is important to distinguish between gamified elements and general game elements, and to combine various gamified elements to ensure the effectiveness of the game [6].

In the implementation of science gamified instruction, Alkinoos-Ioannis and other scholars suggest that teachers should use personalized methods to assess young children's game types and provide targeted teaching strategies and materials during activities [7]. Additionally, Fischer argues that personalized methods should be employed, with teachers using gamified approaches to create distinct learning paths for different students, thereby stimulating their intrinsic potential to solve real-world problems [8].

In numerous studies by domestic and international scholars, research has focused on two directions: the design strategies and implementation strategies for teachers designing gamified science activities, and proposed solutions by combining the characteristics, functions, and elements of gamification. Through an analysis of the research, this paper found that there are many studies on gamified teaching and science education activities, but there is still room for exploration in applying gamified teaching to science education activities. Based on this, this study combines the two to explore the design and implementation of gamified teaching in science education activities.

## 2. Meaning, objectives, and effectiveness

### 2.1. Science education activities

The Ministry of Education categorizes preschool education activities into five major domains, with science education activities being one of the five domains of preschool education. It focuses on learning activities related to the science domain, which are divided into group science instruction activities, zone science activities, and science activities in daily life [9]. Scholars Zhang Ailing and Li Shuting believe that science education activities serve as a platform for young children to engage in inquiry and problem-solving [10]. Scholars Xu Xiaorong and Zhang Haio believe that science education activities are a process through which young children acquire scientific knowledge and experience, cultivate interest and attitudes, and develop scientific inquiry skills [11]. In general, the meaning of science education activities refers to young children engaging in autonomous activities such as perception, observation, discovery, and manipulation of the natural world (including artificial nature) under the guidance of teachers, posing questions, and seeking answers through an exploratory process [12]. In this paper, science education activities focus on group science teaching activities, which have the characteristics of being suitable for young children's concrete imagery, relying on teacher support, being actively explored by young children, and being oriented toward all young children.

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## 2.2. Game-based teaching

### 2.2.1. Definition of gamified teaching and its effectiveness in preschool education activities

Gamified instruction refers to a method that integrates various game elements or gameplay mechanics with educational content and applies them in actual teaching activities [13]. It features clear achievements or progress, social interaction, and immersion, among other characteristics, which correspond to the elements of games.

In terms of effectiveness, scholar Zhao Yinquan found that applying gamified instruction in mathematics significantly enhances teachers' instructional proficiency and professional capabilities. For young children, gamified instruction fosters active participation, a competitive spirit, a focus on outcomes, and notable improvements in personalized and innovative thinking [14]. Professor Gao Yang applied gamified teaching to picture book reading and found that children's interest and participation levels increased, and their understanding of picture books and reading quality improved significantly [15]. It can be seen that applying gamified teaching to preschool education activities can effectively enhance teachers' teaching proficiency and improve teaching quality; promote children's participation and ability development, among other benefits.

### 2.2.2. The implementation and effectiveness of gamified teaching in science education activities

In the process of applying game-based teaching to scientific education activities, game-based elements are implemented in four aspects: creating scenarios for scientific activities, designing tasks, using materials, and evaluating [16]. In the creation of scenarios, the use of Gamification can create scenarios that meet the characteristics of students' interests, so as to improve their learning motivation [6,14,17]. In the aspect of Gamification tasks, Gamification is more integrated with scientific knowledge points. By transforming abstract and hard-to-understand scientific principles into specific, operable, and age-specific Gamification tasks, children can learn scientific knowledge spontaneously, so as to cultivate their exploration spirit [15]. In the use of materials, researchers can use some game materials with game elements, such as cards, to stimulate students' interest and acceptance, to maintain a positive learning attitude, and obtain experience of relevant knowledge [17]. In terms of evaluation, teachers can use the ranking and customs clearance elements of the game to judge the children's mastery of knowledge, participation and interest, to guide them accordingly; Teachers can also evaluate their teaching behaviors based on the participation of children, the use of game materials and the final ranking, and adjust them in a timely manner. In general, game teaching can help teachers judge the teaching quality and the effectiveness of teaching methods through the visual learning process and results. Through the plots and appropriate tasks of the game, the interest of teaching activities can be increased, the initiative and challenges of children's learning can be increased, and different inquiry methods can be guided.

## 3. Problems

### 3.1. Design and implementation of scientific education activities

Starting from the basic guarantee of education, some kindergartens have the problem of insufficient regional space for scientific education activities. Due to the different kindergarten based courses, kindergartens will create relevant areas and a classroom environment according to their characteristics. As a result, it is easy to see the imbalance of regional distribution and the lack of scientific regional space, which leads to the failure of teachers to put in sufficient materials and

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extend after class, and ultimately affects the implementation of scientific education activities. In addition, although the Ministry of Education emphasizes the development of five major areas of children, some kindergartens still attach importance to a single area, such as the art field, the language field, etc., weakening activities in other areas, especially teaching activities in the field of science.

Starting from the influencing factors of teaching quality, it is divided into the teaching level, teaching content and implementation methods of teachers. The teaching ability level of teachers includes guidance and interaction, and there is a lack of in-depth problems for teachers to guide children to explore. The time and opportunities for children's inquiry and thinking in the activities were insufficient. Teachers provide too many feedback supports for children.

In science education activities, teachers seldom organize children to discuss the causes of the phenomenon, children's guesses and how to find the causes from the perspective of scientific phenomena. It usually guides children to analyze more present, simple and descriptive facts. In this regard, the response type of children is mostly micro cognitive response. On the contrary, open analysis and reasoning are carried out, and deep questions are asked. Children's response type will be transformed into a high cognitive response, and the learning quality is higher than the simple and descriptive facts presented by a single analysis [18]. In addition, the study found that teachers who provide enough time for children to explore and think can better guide children to actively think and explore, causing children's high cognitive response. In the activity, teachers are used to providing feedback support for children, helping children learn, helping children analyze, reason, experiment and verify. However, teachers lack a comprehensive understanding of children's actual development level, and a large number of scientific teaching activities are constantly provided with brackets, so there is a repetition of children's experience, leading to the use of some brackets not being effective [18].

From the content and implementation method of teaching activities, there is an imbalance in the selection of scientific education content; The implementation methods are diversified, but there are differences affected by the educational background and qualifications of teachers. Among the four fields of material science, life science, earth and space science, and science and technology, the choice of teachers is mostly in the field of life science, followed by the field of material science. Because the two areas are close to children's lives, the difficulty is low, and the cost and type of activity materials are low. Teachers will give priority to the two parts, resulting in an imbalance in the selection. In the implementation of activities, the specific implementation methods of teachers include: operation method, observation method, experimental method, etc. Lu Yan scholars found that the implementation method of science education is affected by the educational background, age, qualifications, and other factors of teachers. With the increase of influencing factors, the organization and implementation level of teachers presents an increasing trend and a positive correlation.

### 3.2. Design and implementation of game teaching in science education activities

In the process of applying game teaching to scientific education activities, Lamu scholars found that there were problems such as the single situation creation, the lack of games in scientific tasks, the lack or improper selection of game materials, and the lack of games in the feedback mechanism [16].

When creating a game-like situation of scientific activities, the creation of the situation will be limited by the layout of the classroom or the ready-made teaching aids and pictures. Teachers design interesting and attractive situations according to children's characteristics, which leads to children's

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inattention and lack of interest. In the design of scientific tasks, most of the tasks are still in the form of lectures and demonstrations. Lack of game elements, children will be in a passive state, so they lack enough motivation and exploration spirit in completing tasks. The lack or improper choice of game materials will affect children's freedom and creativity in exploration, so a to obtain negative exploration experience. In addition, the feedback mechanism is lack Gamification, and teachers are still dominated by traditional tests and teacher will affect children's learning motivation and self-confidence. When children are difficult to get immediate positive feedback and a sense of achievement, it is easy to generate pressure and be moved, and it will also dampen their enthusiasm for continuous exploration [17].

## 4. Suggestions

In terms of regional creation of kindergartens, kindergartens should not only create space in characteristic fields, but also pay attention to the balance of spatial layout in the five major areas. Kindergartens can increase the investment of funds and the training of teachers, so as to improve the environmental planning ability of teachers and increase the investment in open and multi-structured materials. Help teachers to create and regularly adjust the space related to the five fields, create the environment for scientific education activities, and support the follow-up extension of activities, to consolidate children's new experience. In addition, the application of game teaching in scientific education activities can also help some kindergartens to create unique kindergarten-based courses.

In terms of teachers' teaching level, teachers should ask more questions, such as "Why is it like this?" "Guess what will happen next" to guide children to explore deeper issues. In the activities, it should provide more time and opportunities for children to explore and think. Zhao Jiaran, a scholar, conducted an empirical study on the interaction between teachers and children in the teaching process, and found that when teachers directly replace children to complete the experiment will reduce children's interest and reduce their desire to explore and solve problems. On the contrary, through group operation or some scientific games, such as the "cage animal" game, the scientific knowledge of the abstract visual residues is changed into "animation", helping children explore and feel the principle of visual residues and animation production [19]. In terms of feedback support, teachers should provide appropriate help to children according to their current developmental zone, and retain children's own exploration space. In the process of scientific teaching activities, teachers can prepare different supports in advance according to different difficulties, guide children to choose whether they need help, and avoid excessive support. In terms of teaching content and implementation channels, kindergartens should provide multi-channel training channels, such as on-site training, weekly discussions, online lectures, etc., to improve the professional ability of teachers, and carry out curriculum deliberation and a one-class multimodal for teachers in the park, to avoid the imbalance of content selection.

In the application of game-based teaching, Zhao Yinqin pointed out that teachers can increase interest and participation through game-based teaching methods, such as scenario introduction, so as to trigger children's independent prediction and comparison, and create activities that children are interested in. For example, in the form and space teaching activity "shadow game", most of the children are interested in participating in the game and obtaining satisfactory game results under the guidance of teachers. They will cooperate and negotiate and constantly try to complete the game process and produce satisfactory work. In this process, children's inquiry ability will have been developed, and children have gained positive learning experience in the process. Some empirical studies use various sensory games and operational and competitive games to implement teaching activities. Through practical application, it is found that such game-based teaching methods can

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attract children's interest and guide children's existing experience of active expansion. For example, in mathematics game-based teaching, children are willing to actively draw graphic ID cards, which plays a role in improving children's cognitive ability, enthusiasm, and understanding of graphics [14]. In addition, teachers can also integrate game elements such as goals, rules, scenarios, points system and rankings into the design of teaching links, and design game oriented scientific tasks, such as the task of helping "little squirrel" bridge to guide children to learn the factors affecting buoyancy, and finally consolidate the existing experience gained in the activity through the competition which group uses the least materials.

In general, in the creation of scientific teaching activities, kindergartens should pay attention to the balanced development of the five areas. Teachers should take this as a guide and create a suitable learning situation. In teaching activities, it should use the characteristics of game teaching, such as multiple operations, a clear and appropriate feedback mechanism, to provide sufficient operation opportunities for children. In addition, teachers should improve their teaching ability development level to ensure that the content selection of scientific education activities is balanced and effective.

## 5. Conclusion

Science education activities in kindergartens can promote the development of children's thinking and logical reasoning abilities. In scientific education activities, there are still problems in kindergarten guidance, curriculum creation, and teaching implementation. In this regard, the application of game teaching can help kindergartens create unique kindergarten-based courses, promote children's enthusiasm for learning, and improve the teaching level of teachers' scientific education activities. In the previous studies, there was more research on the two aspects of game teaching and scientific education activities, but there is still room for research on the application of game teaching in scientific education activities. This study explores the application of game teaching in scientific educational activities, providing theoretical support for the combination of the two. In general, game-based teaching is applied to scientific education activities, and children's favorite games are used to help children gain positive learning experience and effective scientific learning methods in the school-age stage, laying the foundation for their future scientific learning.

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