



Implementation and Application Research on Natural Materials in Kindergarten Art Activities under the Concept of Sustainability

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Abstract. With environmental problems becoming increasingly prominent, the concept of sustainability has become a key issue in contemporary development and has exerted a profound influence on early childhood education. This study explores the relationship among teachers' sustainability awareness, their skills in applying natural materials, and the actual use of these materials in teaching under this context. It also analyzes factors that influence teaching effectiveness and discusses strategies for integrating natural material art activities supported by the concept of sustainability. The aim is to provide reference suggestions for subsequent research in preschool education.

Keywords: concept of sustainability, natural materials, art teaching.

1 Introduction

In the present era, human beings enjoy various forms of welfare while also facing growing tension between increasing needs and environmental development. Under such circumstances, the concept of sustainability has gradually become a shared goal for global development and has influenced the direction of human actions. Art education activities in early childhood are a major way for young children to experience, appreciate, and create beauty. They are also an effective means of conveying the concept of sustainability. When teachers use the concept of sustainability as a guiding idea and natural materials as the medium for activities, this approach not only represents an important way for early childhood art education to return to its authentic nature, but also serves as a key bridge connecting children's developmental needs with the requirements of contemporary development. In practical application, the integration of the concept of sustainability with natural material art activities faces various difficulties. The need for interaction between children and nature is not fully satisfied, and their awareness of sustainability has not been effectively stimulated. Therefore, this study focuses on the concept of sustainability, examines the current use of natural materials, and analyzes factors that influence implementation. The goal is to provide practical strategies for natural material art activities in kindergartens.

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2 Literature Review

2.1 Relationship between the Concept of Sustainability and Art Activities

The emergence of the concept of sustainability is closely related to environmental ideas. The World Commission on Environment and Development first clarified this concept in the report *Our Common Future* in 1987. Guided by environmental and development issues, the report pointed out the common challenges faced by humanity and called on people around the world to make joint efforts in environmental protection and economic development. The aim was to build a new and harmonious world^[1]. In 1992, the United Nations adopted several documents at the Conference on Environment and Development, including the Rio Declaration on Environment and Development. These documents further expanded the concept of sustainability proposed in the earlier report. They established the important international status of this concept and clarified the general direction for global sustainable development^[2]. Scholars in China have offered different interpretations of the concept of sustainability. Yifan Wang believes that sustainable development means the appropriate development of natural resources and the promotion of sustainable development for both human society and the ecological environment through protective measures^[3]. Yawen Zhang emphasizes that sustainable development should follow the laws of the ecological environment. Development can be achieved by reserving space for environmental growth^[2]. Although these scholars emphasize different aspects of the concept, they all connect sustainability with environmental issues and future development. This not only reflects the recognition of the report's ideas among some domestic scholars, but also demonstrates the wide influence of this concept.

Early childhood education has special significance for children's physical and mental development and represents the foundational stage of individual growth. Art activities can support the development of children's perception and thinking according to their developmental characteristics. Concerning the relationship between the concept of sustainability and preschool art activities, Nana Shao and Xiaodong Zhou argue that education is a key approach for implementing ecological aesthetic education. To promote ecological awareness, teachers need to integrate art with ecological ideas and establish a professional curriculum system for ecological aesthetic education. In this way, a sustainable space for continuous development can be created^[4]. Liling Wang points out that art activities provide an effective way to convey the concept of sustainability. When children participate in art activities, they directly engage with nature and their emotional connection with nature can be deeply inspired^[5]. Fumin Shen believes that teachers should begin with aesthetic ideas when carrying out ecological aesthetics. The core should focus on the harmonious coexistence between human beings and nature, and attention should be directed to ecological and social issues. Through aesthetic education, people's ecological awareness can be gradually cultivated^[6]. In studies concerning the relationship between the concept of sustainability and preschool art activities, scholars generally recognize the close connection between them. They emphasize that teachers should integrate the concept of sustainability into art education so that children's ecological emotions can be awakened.

2.2 Application of Natural Materials in Art Education

At present, natural education has received considerable attention in Western European countries, and the concept of forest education is particularly prominent. It uses nature as the main learning resource to guide young children to fully experience and perceive the natural world, which clearly reflects the ideas of natural education [7]. The Waldorf education concept also holds that the materials children come into contact with should come from nature. Processed materials may restrict children's imagination and creativity [8]. Jing Wang points out that introducing natural resources into art teaching brings the classroom closer to daily life. This approach helps stimulate children's interest in creation and improves both creative ability and learning outcomes [9]. Yuequn Wu notes that natural materials are closely related to human life and can help improve children's life skills [10]. Qing Xu emphasizes that natural materials have natural and everyday characteristics. By providing such materials, teachers can activate children's life experience and allow teaching activities to connect naturally with real life, which promotes deeper learning among children [11].

The use of natural materials is closely related to the concept of sustainability. The concept of sustainability adds ecological meaning to the use of natural materials. Yuequn Wu points out that natural materials come from nature and have environmentally friendly characteristics. The teachers should follow the principles of safety and planning when selecting natural materials. Materials should be chosen in a planned way according to children's cognitive levels so that children's enthusiasm for activities can be stimulated [10]. Although scholars have put forward a series of suggestions, challenges still exist in practice. Chenhui Jiang argues that teachers often have limited understanding of how to use natural materials. As a result, they may not choose appropriate materials according to different activity themes, and they may not adjust teaching according to children's actual conditions [12]. Therefore, this study takes the concept of sustainability as the theoretical foundation. It examines the current situation and causes related to the use of natural materials and further explores strategies for their application. The aim is to provide reference suggestions for future research in preschool education.

3 Research Design

3.1 Questionnaire Design and Survey Participants

In order to understand the situation of art education activities among kindergarten teachers and preschool education interns, this study adopted a convenience sampling method. Frontline teachers from kindergartens with different administrative types and interns majoring in preschool education were selected as the research participants. The questionnaire was developed on the basis of existing scales and a review of related literature. It was designed around four dimensions: teachers' basic information, awareness of the concept of sustainability, professional skills in applying natural materials, and the current situation of natural material use in art teaching. Besides, it also included several multiple-choice questions.

For convenience in presentation, the study uses unified abbreviations for the core concepts in the data analysis and tables. Awareness of the concept of sustainability is referred to as cognition. Skills in applying natural materials are referred to as skills. Teaching application is referred to as application. The first section concerns teachers' basic information and includes five questions. These questions describe the demographic characteristics of the respondents, including gender, identity, educational background, type of kindergarten, and years of experience in education. The second section concerns cognition of the concept of sustainability and includes seven questions. It mainly covers teachers' understanding of the concept of sustainability, their familiarity with integration practices, their willingness to cultivate children's awareness of sustainability, and their views on integrating the concept into teaching. These items are measured using a five-point Likert scale. The scores range from 1 to 5, which correspond to "strongly disagree", "disagree", "neutral", "agree", and "strongly agree". The third section examines professional skills in applying natural materials and includes seven questions. It mainly focuses on whether teachers possess relevant professional knowledge, their willingness and ability to design activities, and their willingness to improve their professional competence. These items also use a five-point Likert scale. The scores from 1 to 5 correspond to "not at all consistent", "not very consistent", "average", "mostly consistent", and "fully consistent". The fourth section examines the current situation of natural material use in art teaching and includes nine questions. These questions address teachers' willingness to carry out integrated art activities using natural materials, the selection and use of such materials, the current situation of teacher guidance, and the factors that influence the implementation of these activities. The scores range from 1 to 5, corresponding to "never", "rarely", "sometimes", "often", and "always".

The survey was conducted through an online questionnaire platform, Wenjuanxing. A total of 167 questionnaires were distributed, and 167 were returned, resulting in a valid response rate of 100%. The sample included teachers of different genders, identities, educational backgrounds, kindergarten types, and years of teaching experience, which provides a certain degree of representativeness.

4 Research Results and Analysis

This study mainly used the software SPSS 27.0 to analyze and organize the data collected from the questionnaires. First, correlation analysis and regression analysis were conducted to examine the relationships and the degree of influence among cognition, skills, and application.

4.1 Common Method Bias and Reliability and Validity Analysis

This study used Harman's single-factor test to examine common method bias. The results show that the variance explanation rate of the first unrotated factor is 37.983 percent, which is lower than 40 percent. This indicates that there is no serious common

method bias in this study. The data therefore show a reasonable level of authenticity and can be used for further analysis.

Using the statistical software SPSS 27.0, the reliability of the three scales in the questionnaire was tested with the Cronbach's Alpha coefficient. This coefficient was used to evaluate the reliability of the measurement items in each scale and is expressed by α . The results show that the α coefficients for the cognition, skills, and application scales are 0.844, 0.847, and 0.862. All α values are higher than 0.7. The α coefficient of the overall scale is 0.920, which is higher than 0.8. According to the reliability evaluation standard, the scales used in this study show good reliability, which ensures the reliability of the following research process. The validity of the study was tested through the KMO value and Bartlett's test of sphericity for the overall scale. This test was used to judge whether the variables in the study are suitable for factor analysis. The KMO value in this study is 0.915, which is very close to 1. The coefficient range of the KMO test is between 0 and 1. The closer the value is to 1, the better the validity of the questionnaire. The Bartlett's test of sphericity value of the overall scale is 1579.249, and the significance level reaches 0.000. These results show that the questionnaire has good validity, which supports the effectiveness of the subsequent analysis.

Principal component analysis was carried out for the data of the cognition, skills, and application scales. Only one factor was extracted for each scale. The results show that the KMO value of the cognition scale is 0.894, the KMO value of the skills scale is 0.886, and the KMO value of the application scale is 0.887. The significance level of the three scales reaches 0.000 ($P < 0.05$). The variables among the scales are independent and statistically significant, which is helpful for the further development of the study.

4.2 Correlation Analysis

Pearson correlation analysis was used to further explore the relationship between cognition, skills, and teachers' level of application. The results of the correlation analysis were used to evaluate whether there are relationships among the three variables. As shown in Table 1, the correlation coefficient between cognition and skills is 0.564 with $P < 0.01$. The correlation coefficient between cognition and application level is 0.543 with $P < 0.01$. The correlation coefficient between skills and application level is 0.661 with $P < 0.01$. These results indicate that there are significant positive correlations among cognition and application, cognition and skills, and skills and application level. Therefore, it can be concluded that cognition, skills, and application level are significantly and positively correlated with each other. Among them, the relationship between skills and application level shows the strongest correlation.

Table 1. Correlation Analysis Results of the Cognition, Skills, and Application Scales

	Cognition	Skills	Application
Cognition	1		
Skills	0.564**	1	
Application	0.543**	0.661**	1

**Significant at the 0.01 level (two-tailed).

4.3 Regression Analysis

To further clarify the relationship among cognition, skills, and application level, this study constructed a multiple linear regression analysis model. In this model, cognition and skills were taken as independent variables, and teachers' application level was taken as the dependent variable. As shown in Table 2, the value of R^2 is 0.480. The model can explain 48.0 percent of the variation in application. The overall fit of the model is good. The result of the F test shows that the significance value p is 0.000***, which indicates statistical significance. Therefore, the model basically meets the required conditions. The collinearity results show that all VIF values are 1.466 and lower than 10. This means that there is no serious multicollinearity problem in the model and the model construction is appropriate.

The standardized regression coefficient of cognition is 0.25 ($t=3.684, p<0.001$). This indicates that teachers' cognition of the concept of sustainability has a significant positive influence on the application in teaching practice. The regression coefficient of the skills scale is 0.520 ($t=7.643, p<0.001$). This result shows that teachers' skills in applying natural materials have a significant positive influence on the application of art teaching.

Table 2. Regression Analysis Results of Cognition, Skills, and Application

	Unstandardized Coefficient	Standardized Coefficient	F	R^2	t	Sig.	VIF
(Constant)	0.346				0.128	0.898	
Cognition	0.384	0.250	76.062	0.480	3.684	0.000***	1.466
Skills	0.655	0.520			7.643	0.000***	1.466

a Dependent variable: Application; * $P<0.05$ ** $P<0.01$ *** $P<0.001$

5 Conclusions and Recommendations

The results of the data analysis in this study show that teachers' cognition of the concept of sustainability and their skills have a significant positive influence on the effect of application. Specifically, when teachers have an understanding of the concept of sustainability, know practical ways to integrate the concept of sustainability into art teaching activities, and show willingness to cultivate children's awareness of sustainability, they are more likely to carry out art activities that combine natural materials, pay attention to ecological protection, value resources, avoid waste, and convey the concept of sustainability. On the other hand, when teachers are able to select appropriate materials according to children's age characteristics, design corresponding art activities, and actively take part in training or teaching research activities related to natural materials and the concept of sustainability, their performance in applying the concept of sustainability in teaching is also stronger. Therefore, teachers' professional knowledge related to

sustainability activities, their art activity design ability, and the improvement of their professional competence in sustainability are key factors for the later application of natural materials in integrated art activities.

Cognition of the concept of sustainability is the theoretical foundation for the application of natural material art activities. It shapes the value orientation that teachers follow when carrying out activities. At the same time, skills in applying natural materials form the key link that turns teachers' cognition of sustainability into practical action. Only when teachers work with the support of the concept of sustainability and turn their application skills into real practice in art activities can children's sustainable development be truly promoted. Teachers should pay attention to the influence of the concept of sustainability on children's development. They should gain a deep understanding of this concept and grasp its core meaning. The goals should include respect for nature, rational use of resources, maintenance of ecological balance, and harmonious coexistence between humans and nature. Based on these goals, the concept of sustainability should be integrated into practical teaching activities. In addition, teachers should maintain an awareness of lifelong learning and continue to strengthen their own professional vitality. They should take the initiative to carry out integrated activities and try to overcome professional burnout. Teachers can transform their enthusiasm for learning into motivation for activity design. They should also reflect on and improve their teaching in practice so that their professional skills can continue to grow.

Under the concept of sustainability, teachers should fully consider safety, educational value, and suitability when selecting natural materials. They should explore the diverse educational value contained in these materials. Regarding the ways of obtaining natural materials, kindergartens should provide stronger support for materials and make active use of environmental education resources in order to broaden the channels for obtaining natural materials. During activities, teachers should explore the educational value of natural materials in depth and develop different forms of expression. Teachers should also create many opportunities for children to have direct contact with nature. Children should be encouraged to take part in the collection, cleaning, recycling, and storage of natural materials. This can stimulate children's ecological awareness and improve the quality of natural material art activities.

Teachers' participation in professional training is an important way to improve their skills in applying natural materials. Kindergartens should strengthen their support for the development of teaching activities. They can enrich material reserves and establish a natural material resource bank. They can also improve the system for recycling and storing natural materials and encourage teachers to creatively develop related courses. In addition, kindergartens should create different opportunities for teachers to take part in further study, training, and observation activities. High-quality educational resources can be introduced so that teachers' professional theoretical knowledge and practical skills can be enriched through different channels. In this way, the quality of natural material art activity application can be improved.

This study takes the concept of sustainability as the starting point and uses a questionnaire survey to investigate teachers' application of natural materials in art activities. It identifies key factors that influence the implementation and application of natural materials in kindergarten art activities. The study has practical value and contribution.

However, some limitations still exist. The total number of questionnaire samples in this study is relatively small, and this may lead to homogeneity in the sample. The results therefore do not have broad representativeness. In future research, the scope of the questionnaire survey can be expanded and the sample size can be increased. A stratified sampling method can be used to balance the sample structure and obtain more comprehensive data. In addition, this study only presents the surface relationships among cognition, skills, and application. The deeper relationships among these three aspects were not further explored. Future research can adopt multiple research methods. Case analysis and interviews can be used to form triangulation verification so that the relationships among these factors can be examined in greater depth.

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