Curriculum and Teaching Methodology (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/curtm.2024.070117
ISSN 2616-2261 Vol. 7 Num. 1

A practical study to support the construction of mathematical core experience in young children through play

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Keywords: Game, children's learning, mathematics core experience

Abstract: Play is the basic activity of young children, and in the process of individual development, mathematics as a "special intelligence" is often regarded as an important part of intelligence, and the development of mathematical intelligence is highly dependent on the generation and development level of the individual's core experience in this field. This experiment uses the TZG curriculum model "Preschool Children's Observation and Recording System" as the evaluation tool to observe the current situation of the development level of children's core mathematics experience in game activities in a kindergarten in Chengdu. We propose strategies to solve the problems of slow updating of game environment creation materials, unclear role positioning of teachers, and lack of evaluation of children's achievement of core mathematics experience. It is suggested to start from many aspects, such as creating an open game environment, changing teachers' concepts, paying attention to children's active learning and constructing diversified game activity evaluation methods. In this way, educational recommendations are putting forward to promote the learning of mathematics in young children, with a view to supporting teachers to understand and penetrate the core experience.

1. Introduction

In the preschool stage, play is an autonomous activity with the highest probability of occurrence and the longest participation time in addition to life activities and learning activities. It is in this sense that play becomes a basic activity for young children[1]. Through active participation, exploration and accumulation of experience in play, children are more able to form their own thinking patterns and cognitive structures. The goal of mathematics education in the Learning and Development Guide for Children Aged 3-6 is to "be able to feel the relationship between the number, quantity, shape, and spatial position of things from life and play"[2]. This goal further clarifies the value orientation and knowledge scope of 3-6-year-old children's mathematical cognition and development, and points out the direction for mathematics education. In addition, mathematics as a "special intelligence" is often regarded as an important part of intelligence in the process of individual development, and the development of mathematical intelligence is highly dependent on the generation and development level of the individual's core experience in this field[3]. The core experience is the Chinese elaboration

of the key experiences contained in the foreign Haieskop curriculum, which is used to describe its development in the fields of sociality and cognition, which is an indispensable part of early childhood development. The designers of High and Scope take "key experience" as the learning content, and summarize the core concepts of children's mathematics learning and development into five aspects: numbers and points, patterns, geometry: shape and space awareness, measurement, and data analysis[4]. These core concepts in the field of mathematics are also known as core experiences, and their connotations and extensions are basically the same. Previous studies have divided mathematical games into operational games, mathematical intellectual games, and competitive mathematical games. Through the gamification design of mathematics learning content in kindergartens, scholars promote children's mastery of mathematical logic knowledge from concrete to abstract[5]. Since then, more scholars have begun to explore the improvement of children's mathematics gamification in the kindergarten teaching process, so as to promote the development of children's mathematics experience. In this study, we mainly classified the different areas of the game and defined the mathematical games as the games that operated the mathematical materials in the outdoor area and the indoor mathematics area of the kindergarten. Although teachers continue to promote the development of children's mathematics ability in life and play, they lack understanding of how to evaluate and promote children's mathematics learning. Therefore, this paper analyzes the characteristics of the development of children's core experience in mathematics in game activities, and puts forward educational suggestions to promote children's mathematics learning, in order to provide support for teachers to understand and penetrate the core experience.

2. The theoretical basis of empirical construction

2.1. The theory of empirical active construction

Constructivism reduces knowledge to an interpretation, and the acquisition of knowledge is constructed through dialogue between the cognitive subject and the empirical world, and in the process of construction, the schema of the individual will also change as the experience continues to expand[6]. Constructivist learning theory emphasizes the learner's initiative in the learning process, highlighting the role of meaning construction and experiential environment in learning. The constructivist view of learning believes that learning is the process of individual meaning construction, and its focus is on the process of learners actively receiving knowledge and constructing their knowledge framework, so as to gain experience. For the constructivist view of knowledge, situations are pluralistic and concrete, and constructivism encourages the combination of learning content with real-life situational practice, and the application of knowledge to real-world practice for meaning-making.

2.2. Learn advanced theories

Learning advancement is a new concept that emerged in the reform of science education in the United States in the early 21st century, and it is also one of the research hotspots in the current research field of science education in the United States. In 2005, the National Research Council (NRC) of the United States first explicitly proposed learning progression in the National Science Evaluation System, affirmed its important value as an effective tool to promote the consistency of curriculum standards, classroom teaching, and examination evaluation, and emphasized the positive significance of learning progression in the development of individual learning thinking[7]. The educational philosophy advocated by Learning Progression is also applicable to other areas, including pre-school education. Learning progression emphasizes that learning is a process of continuous accumulation and development, and that learners' understanding of core experiences needs to go through many

different intermediate levels. Within a certain period of time, with the right teaching strategies and activity organization, children's understanding and application of this core concept will gradually develop and mature. This development is the result of the interconnectedness and interaction of multiple factors[8].

3. Research Methodology

3.1. Research object

In a public kindergarten in Chengdu, 28 children (15 girls and 13 boys) were observed, and 4 children (2 boys and 2 girls) were selected for each activity combined with video recordings.

3.2. Research tools

In this study, the "Preschool Children's Observation and Recording System", a child evaluation model developed under the concept of the TZG curriculum, was used as a research tool, and observation-based developmental evaluation was carried out through the sub-domain mathematics part of the evaluation system. The evaluation tool records children's behavior and language in daily life or when playing and interacting with teachers, writes anecdotal records, collecting information about children's development. And it determines children's current development according to the corresponding standards of the "Preschool Children's Observation and Evaluation System".

For this mathematics evaluation item, this area includes five observation items: numbers and points, geometry: shape and spatial awareness, measurement, patterns, and data analysis, taking numbers and points as an example, and their levels of 0-7 are shown in Table 1.

Table 1: Indicators of the Preschool Child Observation and Recording System

Level 0	A toddler looks at, touches, or manipulates an object
Level 1	Young children ask for "more" with words, gestures or phrases
Level 2	Children use numerals or count mechanically
Level 3	Toddler (one-to-one correspondingly) Objects with a continuous count of 10 or less
Level 4	Toddlers can recognise 4 or more single digits
Level 5	Children can count more than 10 objects (the number corresponds to the object) and report the total number according to the last number
Level 6	Toddlers can name how much more or less one group is more or less than the other
Level 7	Young children can combine and break down a number in two or more ways

3.3. Research methods

In this study, observers took a non-participatory observation method in a natural situation, directly observed children's activities in play, and used a specific method combining graded observation and anecdotal observation records.

4. The current situation of the development of children's mathematics core experience in game activities

In this study, according to the kindergarten curriculum, play activities are divided into outdoor play and indoor area play according to the use and materials of play, and Lieberman believes that play can be regarded as a basic feature of play activities, and play can also be regarded as an individual's personality tendency or personality trait[9].The core experience of mathematics learning and

development focuses on the foundation and key knowledge and abilities of mathematics, and is also coherent and developmentally appropriate to the future literacy of mathematics in preschool children, and the core experience is the most basic and critical concept and ability that preschool children can acquire at this age and development stage[10]. In line with the concept of constructivism, core experience is not the "static knowledge" of the "subject center", but a comprehensive system of knowledge, abilities and qualities that reflect the learning and development process of young children[11]. For young children, mathematics is not just about mechanical points, children like to count real objects, they like numbers. When the children were playing various building blocks and board games in the math area, the bronze tree next to the small party was fascinated, and then asked the teacher how many birds were on the tree. The teacher said how many do you think? However, because Mr. Yang introduced that there were 9 birds on the tree in the early stage, and there were only 8 on the tree at present, and she was not sure of the real number of birds on the tree. Developing a sensitivity to mathematics from math points enhances the development of the core experience of math points, and children learn geometry when they put together puzzles and building blocks. The children are playing puzzles in the math area, constantly making puzzles by observing the reference template, trying repeatedly according to the information, and recognizing and exploring geometry in the new method of trying to quickly puzzle. However, when the toddler saws the last piece of wood, he uses visual inspection rather than tool measurement to cut. According to the level of development measured in the "Preschool Children's Observation and Recording System": Kaige and Yuan yuan can directly compare objects according to their measurable properties in play activities, but they cannot follow standard measurement procedures for measurement, and are at level 4.In the outdoor sand area, Yuan Yuan and Mianmian, who had been playing kitchen games in the sand area, were curious about the scale, so they asked the teacher what it was, and became curious about the balance scale that the teacher had put into the sand pit material area, and then carried it to the sand area to explore the light and heavy under the teacher's prompting, but stopped the activity after only two minutes of exploration because of the noon time. In the process of exploring the balance scale, Yuanyuan used words such as "heavier here", and Mianmian was able to gain weight after comparison, "I need to add some more here", which was at level 4. In the game activity, you can use the core experience of mathematics to solve problems and gain experience development, in the Lego room Liuyi wanted to build an amusement park, but encountered difficulties in using pipes to build a slide, at first the direction of the slide was to the right, after many failed attempts, Liuyi changed the direction and continued to build the slide and succeeded. In the follow-up, the teacher asked how to build a successful project, and he replied: "Because the slide I used to play in the park is like this." In the whole process of the activity, they can use their previous experience to solve the problems they are currently encountering, so as to they can truly come from life to life.

Through the analysis of the above cases, it can be seen that the development of supporting the construction of children's core experience in mathematics in game activities is not only the active learning of children themselves, but also the creation of a supportive environment for teachers' understanding of core experience. Some children have a moderate level of math core experience development, but are able to try to solve problems through exploration and experimentation in play activities. The main problems include the slow updating of play materials in a supportive environment, the lack of clarity about the role and concept of teachers, and the problem of teacher evaluation during and after play activities.

4.1. The update of game environment creation materials is slow

At present, there are too few types of materials in many game environments, and the update speed is slow, and the use of this kind of cookie-cutter repetitive materials reduces children's hands-on

interest and creative ability. The main reason for this is that teachers believe that many game materials are easy to obtain, have few operation processes, and are highly playable, so they do not need to be replaced frequently, and children can continue to reuse them. They ignore the fact that young children's patience with play is limited and they get bored easily with the same play environment. If the materials in the play area are not updated in a timely manner, it is easy for young children to lose interest in the materials. In the kindergarten, whether it is in the nursery, kindergarten or kindergarten, basically the same play materials are placed in the area. Because these materials are too monotonous, they cannot fully stimulate children's interest in learning, so that the regional game cannot fully mobilize the enthusiasm of children's participation, which is not conducive to the development of regional games, and is not conducive to children's physical and mental health.

4.2. The role of teachers is unclear

Preschool teachers must clearly grasp the core experience in the field of mathematics when organizing and carrying out early childhood mathematics education activities. However, the current situation is that preschool teachers have insufficient grasp of the core experience in the field of early childhood mathematics, vague concepts, and inaccurate understanding. Therefore, in the actual teaching process, it is impossible to concretize these problems into children's operations, nor can they explain the truth clearly, and it is difficult to deepen the expansion and refinement of teaching content. At the operational level, the learning and mastery of children's core experience in mathematics are generally integrated into daily life. In some educational activities, teachers can sometimes incorporate the teaching of core mathematics experiences into games and transitions. But these are still at the level of general experience. The learning of children's core experience requires preschool teachers to have a deep understanding and thinking about children's mathematics learning behavior and their own teaching behavior, and to concretize and operationalize the core experience of children's mathematics in specific education and teaching activities, and then to be able to summarize and reflect when explaining, which is the key to carrying out mathematics core experience education activities.

4.3. Lack of evaluation of the achievement of children's core experience in mathematics

In the process of carrying out specific mathematics teaching activities, teachers lack not only high-level teacher-child interaction, but also lack specific, professional means to promote children's core experience learning, such as work analysis, behavior observation and rich teacher-child dialogue, and fail to master systematic observation and evaluation methods of children's mathematics learning behavior. For example, at the end of the activity in the Lego room, the children expressed their reluctance to build the results of their meticulous construction, and the teacher did not evaluate or leave traces of the children's construction, but asked the toys to be quickly taken back and put back in their original places. Therefore, firstly, teachers should have a solid grasp of the core experience and digest it through teaching and research. Secondly, teachers should pay attention to the implementation of the core experience when organizing each teaching activity, grasp and comprehensively evaluate the learning of children's core experience in mathematics. And finally teachers should reflect on themselves and improve the educational activities to better help children master the core experience of mathematics.

5. Strategies to support the construction of children's core experience in mathematics in games

5.1. Create an open game environment

5.1.1. Bringing regional activity materials to life

In real life, numbers and shapes go hand in hand, and by providing daily life materials in the play area, children's desire to explore and learn is stimulated. For example, after children have learned a series of geometric shapes such as triangles, squares, rectangles, and circles, teachers can put wood chips of the above shapes in the play area, and attach patterns such as people, animals, and buildings. Secondly, limited to children's cognitive level, it is difficult for children to correspond to symbols, quantities, and concepts. For example, in the construction area, the children said that they had built an unfinished building, but the children around them said they did not understand. Teachers can use the scene materials to construct situations or put pictures of relevant buildings for children in regional activities to help children understand. In the same situation and the same material, the teacher changes the pattern and scrolls to visit the materials and set up questions, so that the children can consolidate their spatial awareness, numbers and points in combination with their core experiences.

5.1.2. Create a supportive environment with game elements

As an important carrier and means of kindergarten education, the creation of the play environment should serve the comprehensive and personalized development needs of children through the integration of all educational resources. As a multi-level and multi-functional environmental system, the creation of kindergarten game environment should break through the functional and time-space boundaries of different environments, and highlight the openness of concepts, functions, time and space in the process of creation. Methods such as story situations and actual cases can concretize abstract mathematical concepts, help kindergarten children better remember and understand, and promote learning to become more meaningful[12]. Through gamification, Kindergarten children can successfully solve problems and overcome difficulties, which helps to develop their core mathematical experience.

5.2. Change teachers' concepts and pay attention to children's active learning

5.2.1. Take the core experience as the guide and teach for understanding

Play is the basic form of children's existence, and it is also the basic means for children to understand the world. Kindergarten teachers should pay attention to guiding children to experience the importance of mathematics through play, and continue to acquire and internalize the basic concepts and knowledge of mathematics on this basis. Games are also the basic form of kindergarten education, teachers should make full use of the characteristics of regional games and a variety of corner resources, through different game activities set up about the content and links of mathematics experience, to achieve children's mathematics experience of gamification, vivid and interesting. The combination of games and mathematics experience can effectively improve the boredom of mathematics learning, stimulate children's interest and motivation in mathematics learning, and let children get a good emotional experience of mathematics learning.

5.2.2. Hierarchical game design, in line with early childhood development

According to the theory of advanced learning, children's physical and mental development levels should be considered in the process of setting up game activities, and different levels of gameplay

should be set according to different stages of development. We should let children gain and develop in the process of playing, and at the same time gain knowledge, they can also harvest the methods and fun of knowledge acquisition. Teachers should create some small obstacles for the game within the scope of children's ability, that is, to increase the foothold of thinking and creativity in the game, so that children can obtain something other than their original experience through their own efforts, that is, to achieve success in the challenge. The hierarchical game design in line with children can cultivate a supportive teaching and research system for teachers' professional growth, so that teachers can achieve advanced growth in the teaching and research process, and at the same time, novice teachers and experienced teachers can be developed.

5.3. Construct diversified evaluation methods for game activities

5.3.1. Lead positive evaluation and reflection

The evaluation methods of gamified mathematics activities should be comprehensive and diverse, including guided evaluation between teachers and children, children's independent evaluation, and peer evaluation. Studies have shown that children's cognitive activities in play also produce metacognition[13]. Therefore, teachers lead children to actively self-evaluate and reflect in games, which is essentially developing children's metacognitive ability and fundamentally improving the efficiency of deep learning. In gamified math activities, the emphasis is often anticlimactic, and there is no reflection of children's self-evaluation and peer evaluation. The study found that other children at the same cognitive level were more likely than adults to promote children's experiential learning, using the influence of their peers to teach and learn from each other. Using peer learning experiences can enable young children to gain more intentional experiences.

5.3.2. Construct core experience in mathematics in a timely manner

After the children's monthly "Mathematics Play Day", the teacher first talks and summarizes the activities of the children in the class, but in the activities, they pay attention to multiple evaluation methods in practice, so as to make the learning of the core experience of mathematics in the game more vivid and interesting. It is not necessary for teachers to go to a special teaching and research department for joint discussion, and the observation and recording of children's performance can be evaluated in time at the end of the behavior or the end of the activity. At the end of the play activity, the teacher should conduct an appropriate and comprehensive evaluation based on the activity objectives and the collected children's operations, which is important for children's development[14]. The summary evaluation of the previous activity is an important indicator for the next activity, which solves the problems encountered in the previous activity and can implicitly improve the children's game level in the next activity. Although some individual problems encountered by individual children can be solved in time during the game, it is still necessary for teachers to sort out and sort out some general or group problems after the activity to help children find and analyze the problems and solve them in the next operation activity.

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