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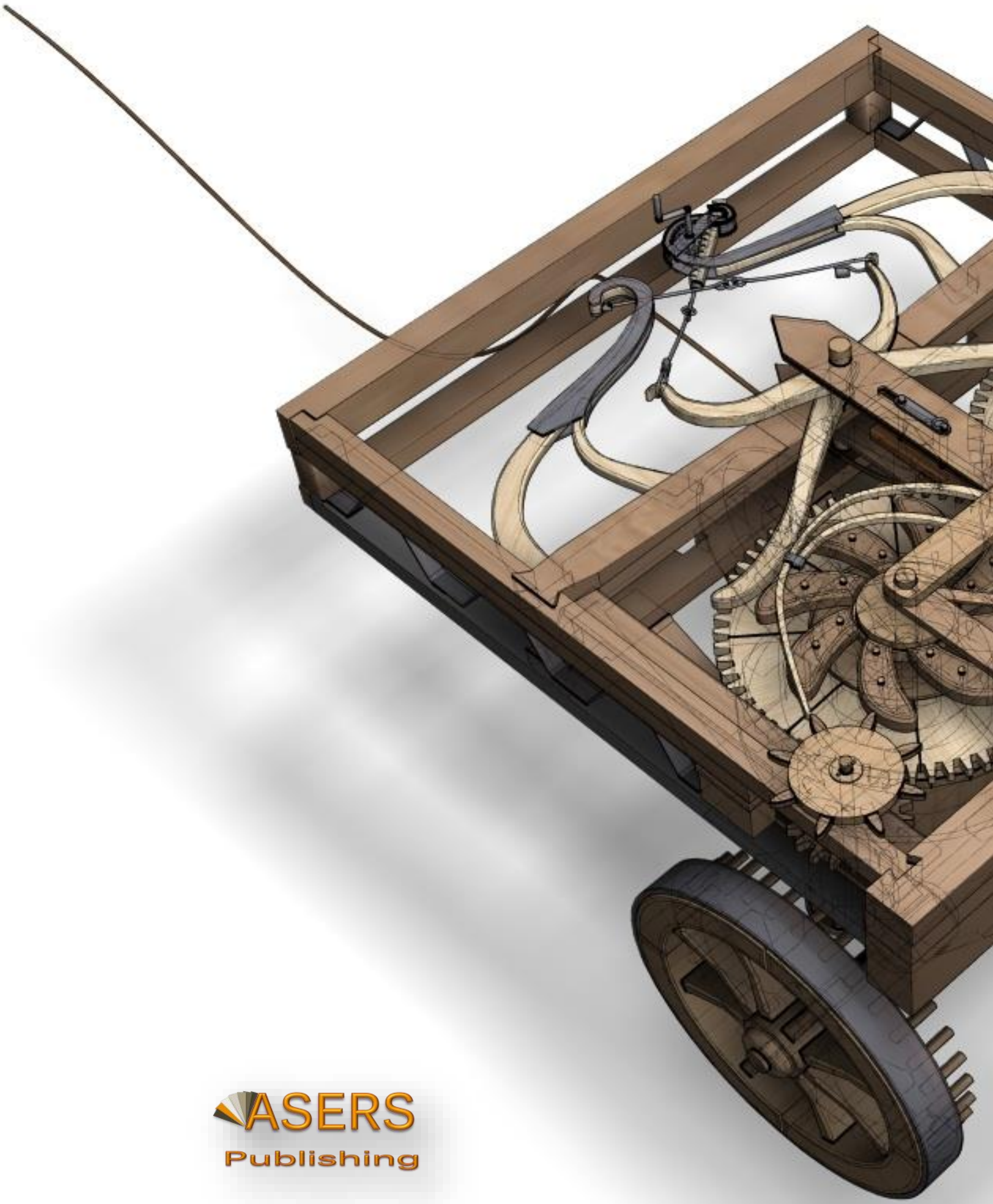

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Call for Papers
Volume XV, Issue 17, 2023
Journal of Research in Educational Sciences

The Journal is designed to promote scholars' thought in the field of education with the clear mission to provide an interdisciplinary forum for discussion and debate about education's most vital issues. We intend to publish papers that contribute to the expanding boundaries of knowledge in education and focus on research, theory, current issues and applied practice in this area.

The Editor in Chief would like to invite submissions for the **Volume XIV, Issue 16, 2023** of the **Journal of Research in Educational Sciences** (JRES).

The primary aim of the Journal has been and remains the provision of a forum for the dissemination of a variety of international issues, empirical research and other matters of interest to researchers and practitioners in a diversity of subject areas linked to the broad theme of educational sciences.

The aims and scope of the Journal includes, but is not limited to; the following major topics as they relate to the Educational Sciences:

- Educational Psychology;
- Engagement and Community;
- Leadership in Education;
- School Improvement;
- Human Resources in Education;
- Education and Information Science;
- Global strategies in Higher Education;
- Learner's Needs in the 21st Century;
- The Role of Education in The Globalization World;
- Technology-Based Learning.

All papers will first be considered by the Editors for general relevance, originality and significance. If accepted for review, papers will then be subject to double blind peer review.

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Action Research on Promoting Spatial Skills Development of Older Children in Block Play

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Abstract: *Spatial skills are an important part of human intelligence and have a profound impact on children's later learning and development of mathematics, and block play, as one of the most fundamental activities in kindergarten, has a positive effect on the development of children's spatial skills. In order to improve children's spatial skills through block play, this study used an action research paradigm to intervene with 30 children in the experimental and control classes over a period of three months. In quantitative terms, the spatial skills of the children in the experimental class showed significant improvements in comparison with those in the control class. In terms of quality, the children in the experimental class used significantly more spatial language in their block play and their level of construction improved significantly. Problem solving skills were developed and interest in constructing was increased during collaborative construction. Teachers who participated in the action research were less 'resistant' to the role of the teacher in block play, and their ability to use block play as a guide for children's spatial skills development was improved. The collaboration of the research team members was a key factor in the success of the action research. Teachers should use different types of block play to improve children's construction skills. Promote peer block building to bring out the unique value of peer construction. Focus on the role of spatial language and encourage children to use it to communicate.*

Keywords: spatial skills; block play; action research.

JEL Classification: I20; I21.

1. Problem and Literature Review

Spatial skills are an important part of human intelligence which involve the skills that humans use to manipulate mentally and physically their environment, the position and orientation of things in it. Spatial skills play a vital role in our everyday lives, for example assembling semi-finished furniture and placing bank cards in ATMs. Spatial skills are also relied upon in all fields from architecture to medicine, helping engineers to construct load-bearing structures in their minds and doctors to interpret medical reports. Spatial skills are also strongly associated with early mathematical learning in young children (Cheng and Mix, 2014; Verdine, Golinkoff, Hirsh-Pasek, and Newcombe, 2017), as well as future achievement in science, counting, engineering, and mathematics (STEM) (Wai, Lubinski. and Benbow, 2009). Spatial skills include the ability to generate mental images, the ability to remember other information as it is processed (spatial working memory), the ability to manipulate and transform these images, and the ability to apply this multi-step spatial processing to reasoning and problem solving. These skills may be able to support the development of foundational mathematical skills, for example, spatial skills have been shown to predict addition and subtraction skills in linear number tasks in the early grades (Gunderson, Ramirez, Beilock, and Levine, 2012). Other studies have also shown a correlation between spatial skills and computational problems and the use of positional concepts (Mix et al., 2016), with spatial skills in grade 1 even predicting mathematical reasoning skills in grade 5 (Casey, Lombardi, Pollock, Fineman, and Pezaris, 2017). Mental rotation and spatial visualization in spatial skills have also been associated with high school geometry problem solving, as well as math achievement and chemistry performance (Kersh, Casey, and Mercer, 2008; Stieff, 2007). Therefore, there is a need to enhance the development of spatial skills in young children, both from the perspective of personal development and to meet the needs of society.

Block play is "a symbolic constructive play activity carried out by young children using blocks as a material basis (Yan Liu, 2008)." As one of the most fundamental activities in kindergarten, block play is an ideal material for young children's mathematical learning. A body of evidence suggests that early block-building skills and experiences predict a range of spatial skills, and that young children who tend to have high levels of construction in block play also develop better spatial skills (Casey et al., 2008; Newman, Sharlene, Hansen, and Gutierrez, 2016; Zhang, Xiaoxia. 2013; Kang, Dan, Hu, Z et al.,2020; Wu, Nian Yang, An Xi, Mao, Yi Meng, 2019). A review of the relevant literature reveals that most of the current research on spatial skills in block play has been conducted through empirical studies and is more at the theoretical level. How can we help early childhood teachers to master the strategies of using block play to promote the development of spatial skills? How do frontline teachers organize block play with young children? Traditionally, simply teaching strategies to teachers has not been effective (Tormey, Liddy and Mccloat, 2008), and having teachers carry out action research in their specific educational practices is recognized as an effective way of promoting their professional development (Elliott, 1991), as the strategies and methods gained from action research can enable early childhood teachers to be more flexible in dealing with complex and changing educational environments (Hocl, 2016). In this study, the paradigm of collaborative action research was adopted, in which frontline kindergarten teachers, preschool teachers and students from the University of Y formed a research community to conduct a three-month action intervention on children's block play as a starting point to explore the pedagogical effectiveness of promoting children's spatial skills development through block play.

2. Research Methodology

The action research approach is "based on actual social situations in which practitioners and experts work together to propose practical solutions to problems, improve plans, and implement, validate, and continually revise them in the context of events to obtain research results (Shih, 2004)." This study is based on the shortcomings of teachers' guidance of children's block play in practice, and is a study to explore the effectiveness of promoting children's spatial skills development through block play, while action research is closely related to specific educational practices, and is a way for the researcher to communicate with kindergarten teachers on an equal and respectful basis about the content of the study, to communicate with each other during the research process, to continuously reflect and to jointly improve the research results. It is a practical research method. Therefore, this study fits in with the idea of action research and this research paradigm was chosen.

2.1. Research Participants

The participants of this study came from Garden B in Yan'an, Shaanxi Province, which is a provincial model garden, but does not have much practical research experience in block play for young children. Two large classes were randomly selected for this study, one of which was the control class, and the other was the experimental class.

Table 1. Basic information of children in the experimental and control groups

	Number of people			Age	
	Male	Female	Total	Average Moonling	Standard deviation
Experimental group	15	15	30	67.17	0.89
Control group	15	15	30	67.73	0.63
Total	30	30	60		

There was no significant difference in spatial skills between the two classes, and the action research method was used to investigate the facilitation effect of block play on the spatial skills of the children in the experimental class. The study content and research process were ethical, and the parents of the study participants would sign an informed consent form. The basic information about the toddlers is shown in Table 1.

2.2. Research Steps

Action research is a kind of "dynamic generative research" that needs to be carried out in the context of changing educational practices, and therefore the researcher needs to modify the program as he or she goes along with the problems encountered in practice (Li Zibiao, 1992). In this study, apart from the first round of action plan, which was based on the observation that the children's level of constructive play was low, mostly in two-dimensional structures, and that the results of the pre-test on spatial skills were low in three-dimensional mental rotation, the second and third rounds of action plan were developed in the light of the problems encountered in the previous round of action research. The second and third rounds of the action plan were developed in the light of the problems encountered in the previous round. Observation is not a separate component, but rather an observation of the whole process, results, and context of the action. The specific program of activities is shown in Table 2:

Table 2. Design and implementation of the three rounds of action research programs

	Event Name	Plan development	Implementing actions	Observations and reflections
Round 1: Mock-ups	Viaduct Ships Kiln in northern Shaanxi Baotashan	The children carry out a mock construction.	1. Place the unit blocks and the supporting materials 'toy cars' and 'little people', etc., and the children will simulate the construction. 2. Before building, the teacher selects different example pictures and guides the children to observe the basic structure of the reference in the pictures. 3. At the end of the block game, teachers and children review the game together and acknowledge the children's progress.	1. Children's enthusiasm for building has grown through mock building, but they are easily distracted by brightly colored support materials. 2. The children's construction is rather random and lacks planning. 3. The children who built alone had a low level of construction and some were unable to complete their work independently.
Round 2: Story Situation Building	Rosie the Hen Goes for a Walk The Good Dirty Harry Born This Way Grandpa DeWolf's Cabin in the Woods	Use picture books for story context building.	1. Replace the support materials in the construction area with non-realistic materials, such as plastic tubes, paper rolls, milk cans, etc. 2. The teacher narrates the picture book story in a lively and interesting way and the children build scenes based on the story. 3. Before building, teachers encourage children to work together to build and to design the scene and details of the build in advance.	1. The children's level of construction has improved, but the work lacks mathematical awareness such as pattern ordering and symmetry. 2. Some of the children did not know how to draw the design and some of them built pieces that did not relate to the previous design.
Round 3: Theme building	Light Rail Transportation Underground Stations Bell Tower	Perform theme building.	1. With the help of videos and field trips, teachers guide children's discussions around the proposition, focusing on the beauty of symmetry and patterns in architecture. 2. For children who do not know how to draw a design, teachers encourage them to	1. Children will use more spatial language in the building of blocks. 2. The block work begins to pay attention to detail and more symmetry and patterns emerge. 3. As children build increasingly complex

	Event Name	Plan development	Implementing actions	Observations and reflections
			draw a picture of the result of their work first. For children whose building work is not related to the design, teachers paste the design made by the children on the display board so that they can check it at any time during the building process. 3. The teacher participates as an equal in the children's block building, providing some scaffolding for the children.	pieces, there are new demands on the number of blocks and the length of play.

2.3. Measurement tools

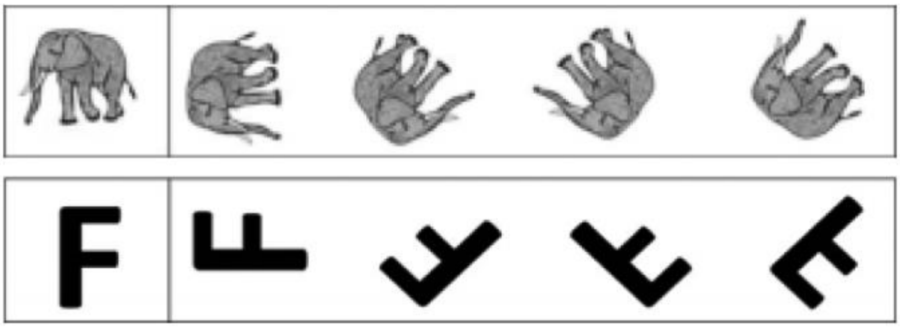
2.3.1. Spatial Visualization Checklist

Block Design from the Chinese version of the Wechsler Scale of Intelligence (C-WYSCI) was used as a measure of spatial visualization in young children. Block Design is a frequently used measure of spatial reasoning and has been used in a number of block play studies to assess spatial skills (Casey et al, 2008). As the Chinese version of the Wechsler Intelligence Scale is available in both urban and rural versions, and the subjects in this study were all from a kindergarten in Yan'an City, the urban version was chosen. The range of the split-half correlation coefficients for the urban version of the Wooden Block Pattern Test was 0.74-0.89. In terms of validity, the correlation coefficient between the Chinese version of the Wooden Block Pattern Test and the WPPSI Wooden Block Pattern Test was 0.6.

2.3.2. Dimensional Mental Rotation Scale

The study used Peter's 1995 version of the Mental Rotation Experiment, in which the type of stimulus presented was a picture of an animal, which was shown to have a Kronbach coefficient of 0.92 and to have good internal consistency. The format is similar to that of Vandenberg and Kuse's (1978) classic mental rotation test, in that the material is presented on A4 paper with the target stimulus on the left side of the page and four stimuli on the right side. Two of the four stimuli are rotated versions of the target stimulus and the other two are mirror images of the target stimulus. There were 16 stimulus items, and the rotations included clockwise and counterclockwise angles of 45, 90 and 135 degrees to the target (Figure 1).

Figure 1. Two-dimensional mental rotation test material

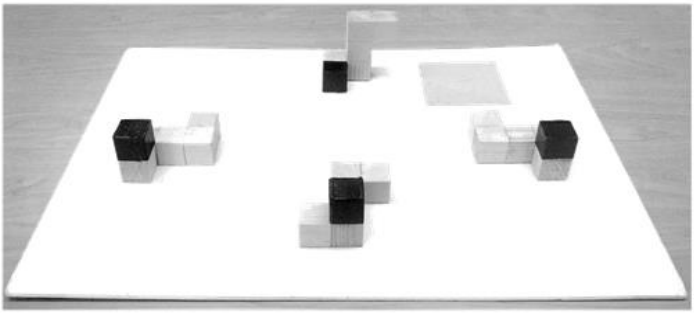


Scoring included three levels of 2, 1 and 0 points. A child who gets one correct in an event is awarded 1 point, 2 correct is awarded 2 points and none correct is awarded 0 points. The total score is a cumulative score for each item.

2.3.3. Dimensional Mental Rotation Scale

The study used Hawes (2015) et al.'s 3D Mental Rotation Scale, which consists of 16 test items, each consisting of four sets of blocks. Each set of blocks consisted of five to six square inches of small blocks glued together, including a blue block, to provide a "mental anchor" for the children, thereby reducing their need for coding and executive functioning. In each group, the target block is glued to the top of a 38 x 50.5 cm white foam board. The other three groups of blocks are made up of a rotated version of the target block, a mirror image of the target block, and a small square with a different structure to the target block. The rotation angle for each item ranged from 45° to 225° (see Figure 2).

Figure 2. Three-dimensional mental rotation test material



Scoring includes two levels of 1 and 0 points. A child is awarded 1 point for a correct selection of an item and 0 points for a non-correct selection. The total score is a cumulative score for each item.

2.4. Statistics

At the beginning of the action research, the spatial skills of 60 children were pre-tested and the spatial skills scores of the older children were analyzed using spss24.0 software. A post-test of the spatial skills was then conducted over a period of 3 months to investigate whether the spatial skills of the children in the experimental class had improved significantly compared to the control class after the action research. It is important to note that the scores on the Chinese version of the Wechsler Intelligence Scale for Wood Block Patterns were converted from raw scores to children's ability scores according to the norm.

3. Research Findings and Analysis

3.1. Quantitative Analysis

3.1.1. Test for Normal Distribution of Spatial Skills in Older Children

The scores of spatial visualization, two-dimensional mental rotation and three-dimensional mental rotation in the pre- and post-tests of both the experimental and control groups were continuous variables, and the p-values of both groups in the pre- and post-tests were greater than 0.05 as shown in Table 3, which indicates that the spatial visualization, two-dimensional mental rotation and three-dimensional mental rotation of the children in the experimental and control groups were normally distributed.

Table 3. Pre- and post-test normality tests for the experimental and control groups

		Kolmogorov-Sminov[a]			Shapiro Wilke		
	Group	Statistics	Freedom	Significance	Statistics	Freedom	Significance
Spatial visualization (pre-test)	Control group	0.142	30	0.128	0.960	30	0.313
	Experimental group	0.146	30	0.102	0.952	30	0.189
Two-dimensional mental rotation (pre-test)	Control group	0.104	30	0.200*	0.964	30	0.394
	Experimental group	0.088	30	0.200*	0.977	30	0.743
Three-dimensional mental rotation (pre-test)	Control group	0.157	30	0.057	0.951	30	0.181
	Experimental group	0.156	30	0.059	0.948	30	0.153
Spatial visualization (post-test)	Control group	0.136	30	0.166	0.960	30	0.318
	Experimental group	0.121	30	0.200*	0.966	30	0.426
Two-dimensional mental rotation (post-test)	Control group	0.087	30	0.200*	0.974	30	0.643
	Experimental group	0.088	30	0.200*	0.965	30	0.423
Three-	Control group	0.143	30	0.119	0.966	30	0.437

	Group	Kolmogorov-Sminov[a] Statistics	Freedom	Significance	Shapiro Wilke Statistics	Freedom	Significance
dimensional mental rotation (post-test)	Experimental group	0.138	30	0.150	0.960	30	0.306

3.1.2. Spatial Skill Scores of Children in the Experimental and Control Groups on the Pre- and Post-Tests

The means and standard deviations of the scores on the pre-test and post-test spatial skills tests for the experimental and control groups are shown in Table 4. At the pre-test level, the scores of the experimental and control groups on spatial visualization ($F_{(1,58)}$ =0.005, p>0.05, η^2 =0.00), two-dimensional mental rotation ($F_{(1,58)}$ =2.03, p>0.05, η^2 =0.03), and three-dimensional mental rotation ($F_{(1,58)}$ =0.54, p> 0.05, η^2 =0.009) on the scores were not statistically significant and the pretest levels of the two groups of children were homogeneous. Post-test results showed that children in the experimental group scored significantly higher on spatial visualization ($F_{(1,58)}$ =11.63, $p<0.01$, η^2 =0.17), two-dimensional mental rotation ($F_{(1,58)}$ =5.01, $p<0.05$, η^2 =0.08) and three-dimensional mental rotation ($F_{(1,58)}$ =13.11, $p<0.01$, η^2 =0.18) than the control group. This indicates that after three rounds of the block play action research, the children in the experimental group developed better spatial skills than those in the control group.

Table 4. Comparison of scores on pre- and post-tests of early spatial skills between the experimental and control groups (M±SD)

Variables	Measurement time	Experimental group (n=30)	Control group (n=30)	F	P	η^2
Visualization of space	Pre-test	6.7±3.65	6.63±3.35	0.005	0.941	0.00
	Post-test	10.43±3.21	7.83±2.67	11.63	0.001	0.17
Two-dimensional mental rotation	Pre-test	19.37±5.53	17.37±5.35	2.03	0.16	0.03
	Post-test	23.97±5.12	20.87±5.6	5.01	0.03	0.08
Three-dimensional mental rotation	Pre-test	6.93±2.6	6.47±2.33	0.54	0.47	0.009
	Post-test	10.67±2.14	8.53±2.42	13.11	0.001	0.18

3.1.3. Repeated ANOVAs of Spatial Skills Test Scores of Older Children

A repeated measures ANOVA was conducted using spatial visualization, 2D mental rotation, and 3D mental rotation test scores as dependent variables, time (pre-test, post-test) as within-subject variables, and grouping (experimental, control) as between-subject variables. Results are shown in Table 5 for spatial visualization ($F_{(1,58)}$ = 4.13, p < 0.05, η^2 = 0.07), two-dimensional mental rotation ($F_{(1,58)}$ =5.16, p<0.05, η^2 =0.08), 3D mental rotation ($F_{(1,58)}$ =6.43, $p<0.05$, η^2 =0.08) group main effects were statistically significant and spatial visualization ($F_{(1,58)}$ =22.65, p<0.001, η^2 =0.28), two-dimensional mental rotation ($F_{(1,58)}$ =23.92, p<0.001, η^2 =0.29), 3D mental rotation ($F_{(1,58)}$ =73.96, p<0.001, η^2 =0.56) time main effect was statistically significant. Spatial visualization ($F_{(1,58)}$ =5.97, p<0.05, η^2 =0.09). The interaction between time and subgroup was statistically significant for the 3-D mental rotation ($F_{(1,58)}$ =6.11, $p<0.05$, η^2 =0.1) and not for the 2-D mental rotation ($F_{(1,58)}$ =0.44, p>0.05, η^2 =0.008), as shown in Table 6. Further simple effects analyses showed that, in the time condition, the two groups of toddlers had similar levels of spatial visualization (P=0.94) and 3D mental rotation (P=0.47) pre-test levels were not statistically significant, indicating that the children in both classes had similar levels of spatial skill development before the action research; at the post-test level, the experimental group had higher post-test scores on spatial visualization (P<0.01) and 3D mental rotation (P<0.01) than the children in the control group, indicating that after three rounds of the block This indicates that after three rounds of action play, children in the experimental group developed spatial visualization and 3D mental rotation at a much higher rate than children in the control group; in the grouping condition, children in the experimental group scored higher on the post-test of spatial visualization ($P<0.001$) and 3D mental rotation ($P<0.001$) than on the pre-test, and children in the control group scored higher on the post-test of spatial visualization (P=0.11) and 3D mental rotation (P< 0.001) also scored higher on the post-test than on the pre-test. Thus, it can be seen as follow, while all children's spatial skills improve to some extent over time, the use of block play better facilitates the development of spatial skills.

Table 5. Analysis of differences between groups in spatial skills between the experimental and control groups

Source	Class III sum of squares	*df*	Mean Square	*F*	*P*	*η2*
Visualization of space	53.333	1	53.333	4.127	0.047	0.066
Two-dimensional mental rotation	195.08	1	195.08	5.16	0.03	0.08
Three-dimensional mental rotation	50.7	1	50.7	6.43	0.01	0.1

Table 6. Analysis of within-group effects of spatial skills in the experimental and control groups

Source	Class III sum of squares	*df*	Mean Square	*F*	*P*	η^2
Visualization of space	182.53	1	182.53	22.65	0.000	0.28
Spatial visualization * Grouping	48.13	1	48.13	5.97	0.02	0.09
Two-dimensional mental rotation	492.08	1	492.08	23.92	0.000	0.29
2D mental rotation * Grouping	9.08	1	9.08	0.44	0.51	0.008
Three-dimensional mental rotation	252.3	1	252.3	73.96	0.000	0.56
Three-dimensional mental rotation * Grouping	20.83	1	20.83	6.11	0.016	0.1

3.2. Qualitative analysis

3.2.1. Changes in Children

3.2.1.1 Children's Spatial Language Increases Significantly in Block Play and Their Level of Construction Improves Significantly

Language supports young children's learning in a variety of cognitive domains, and spatial language, as a form of language, can also facilitate the development of spatial skills (Bowerman, Choi, 2003). This is because the representational system provided by spatial language allows for the interpretation of spatial concepts, such as explaining the relationship between objects, candy in a box, etc. For this reason, the researcher also focused on the development of spatial language during block play, where children used spatial language to translate their tasks and ideas for building the kiln into block creations, for example, 'to enclose it, hurry up and make it inside'. The variety and quantity of spatial language used in block play has also increased significantly, from a focus on block shapes and sizes to spatial orientation and spatial transformations.

Furthermore, we all know that block play contributes to the development of young children's spatial skills, as their level of construction incorporates mental rotation and spatial visualization, both of which are components of spatial skills. Thus, to some extent, the level of construction is an external manifestation of young children's spatial skill development, and increasing their level of block construction can facilitate their spatial skill development (Newman, Hansen and Arianna, 2016; Casey et al., 2008). After three rounds of action research on block play, children's level of construction also began to move from two-dimensional structures to three-dimensional enclosures, for example, in building fences, they moved from initially single-layer enclosures to beginning to use multi-layer enclosures, and some children even began to choose to build walls with staggered heights. At the same time, more pattern sequencing and symmetry emerged in the children's block work, with a gradual increase in detail.

3.2.1.2. In Collaborative Construction, Children's Problem-Solving Skills Are Developed

Block play is a highly open-ended and independent game, rich in opportunities for enquiry. As children build blocks, they are constantly encountering problems and solving them. In the first round of play, children who are building alone will choose to ignore problems they encounter in the building process, such as 'how to build the top of the house'. From the second round of peer-to-peer block play onwards, children chose to be positive when they encountered problems in building blocks.

For example, when the children were building the forest house, Bebe shouted out, "What if we don't have enough blocks to build the yard?" Qiqi looked at the courtyard and at the design and the various architectural patterns pasted on the walls around it and said, "We can build it like this." As he said this, he gestured with his hands. Ryo understood what Qiqi was trying to say and said, "Now we need to take the courtyard down and rebuild it." In a short time, a yard built by staggering the heights was formed. During such play, the less able children develop their problem-solving skills by working with the more able children as they listen and talk.

3.2.1.3. The Children Are More Interested in Building

In terms of affect, this was demonstrated by the children's greater interest in building. In the first round of the study, the children started to play role-playing after building blocks for a while, and their interest in constructing was clearly low. After analyzing the reasons for this, in the second round of action research, the researcher used picture books to guide the children to build in a story context and replaced the support materials in the construction area with non-realistic materials and encouraged the children to build cooperatively. For example, in the story of Grandpa Dewolf's Forest House, the children thought about the number of storeys to be built in the forest house based on the animals in the story and became the main characters in the story to help the other characters solve the problem. In the third round of problem building, the children discuss the theme of the building, for example, "The underground station is underground and there are roads and cars above it, and the cars are fully automatic". The children's construction was not confined to the proposition itself but was based on associations and imagination. At the end of the game, some children commented on how quickly the game had gone by and asked the teacher to give them a memento of their building blocks.

3.2.2. Changes for Teachers

3.2.2.1. Shifts in Attitude Perception

During the interviews with teachers, it was found that kindergarten teachers rarely paid attention to the development of children's spatial skills during block play. to guide them. Based on these two situations, the focus of the action research was on learning and discussing how to implement block play effectively, including reading relevant theories, brainstorming, and reflecting. From the first round of fumbling to the second round of transformation, to the third round of full acceptance, we saw a genuine love for block play, an increase in their level of construction, and the development of their spatial skills. During this process, the teachers of the children in the action groups also changed their attitudes towards block play. For example, some teachers said, "At first I thought that the block area was a very dominant learning area for the children and that we sometimes interfered with the children's block play by giving them too much guidance, but as the action research progressed, I gradually changed my opinion. The role of the teacher as a supporter, observer, sharer, guide and challenger in block play not only improves the children's level of block construction, but also promotes different levels of language, cognitive and social development in the process".

3.2.2.2. Transformation in Environmental Preparedness

In the past, the preferred approach to block play in nurseries has been to allow children to build freely. While this approach gives children more freedom to play, not every child is able to plan ahead, and they are unable to form a concrete picture of 'what' in their minds. As a result, this can lead to many children wandering around the block area and increasing the frequency of playing with each other. For this reason, three block play contexts were created in the action research: mock building, story context building and proposition building, which were increasingly challenging for the children. The materials used in the block area are no longer the same, but the number and variety of blocks are increased according to the theme and the children's level of construction.

3.2.2.3. Transformation of Mentoring Skills

Action research is a dynamic process in which early childhood teachers are encouraged to 'look deeply at the dynamics of play, carefully analyze children's constructed behaviors and interactions, validate and challenge existing practices, and dare to try new approaches to guidance (Mills, 2010)', even if they encounter setbacks in the process. There are also lessons for practice. In the first round of action research, teachers were still either not guiding or over-guiding, but as the research progressed, the teachers were able to understand children's perceptions of space and levels of block construction through naturalistic observations and some informal assessments. In addition, after children had finished their block play, teachers were able to take on the role of sharer, appreciating children's block work and acknowledging their progress. For example, "You have built two rooms, one big and one small, so you have thought of the fact that mummy and daddy's room should be bigger because there are two people living in it, while baby's room should be smaller because there is only one person living in it. You've given it a lot of thought, so please keep talking". Through such targeted responses, the children not only know what is good about their block work, but also feel the teacher's sincerity, which encourages them to continue presenting their own work. Finally, once the children have some experience in building, the teacher can play the role of the challenger and lead them to begin the challenge of drawing a design. Draw designs.

4. Discussion and Educational Suggestions

4.1. Discussion

The effectiveness of using block play to develop children's spatial skills was validated by the improvement in both quantitative and qualitative aspects of the children's spatial skills after three months of the action research intervention. This effectiveness was evident not only in the significant increase in the children's post-test scores, but also in their use of spatial language, their increased level of construction, and their enjoyment of block play. The action groups were also less 'resistant' to the role of the teacher in block play and were increasingly scientific in their instructional strategies for block play. The following is an attempt to summarize the reasons for the success of this study:

4.1.1. Well-Designed Action Research Program and Continuous Reflection During Implementation

Action research is research based on problems encountered in practice, and the researcher can adapt the objectives and instruments according to the situations encountered in practice. In this study, the action research program aims to address the current situation of low enthusiasm and low constructive skills in block play, and on this basis, to try to explore how to develop children's spatial skills through block play.

Firstly, we designed the initial program based on the results of the pre-test and observations of children's block play, with interventions focusing on two areas: spatial language and constructive skills. Secondly, we discussed and adjusted the program in a timely manner based on the issues that emerged from the action research. During the implementation of the action research, the action group teachers would reflect on and discuss the three aspects of the block play, namely the materials used, the teacher's guidance and the children's performance, and write a reflection log after each round. The reflective journal helps the action researcher to "go back" to find the basis of the ideas and "jump out" to think about their own behavior (Zhang Yingchun et al., 2019), which helps the action researcher to reflect on the current activity and to summarize the experience based on the next block game. These help teachers in action research to reflect on the current activity, and to learn from their experiences for the next block game.

4.1.2. Mutual Support of The Research Community

The purpose of action research is to improve educational practice and promote professional growth. In this study, a research community was established with preschool teachers and students, as well as kindergarten teachers, to inspire each other, act together and share with kindergarten teachers in an equal and respectful manner, and to establish a common action philosophy and research vision. During the implementation of the action research, the members of the action group work together to develop an action plan, and then the action is implemented by preschool student A and the experimental class teacher B. During this period, Student A and Teacher B would write a reflective journal based on the block game. At the end of each round of action research, University Teacher C would reflect with Student A, and Kindergarten Teacher B on the strengths and weaknesses of the current round of research so that improvements could be made in the next round of research. At the end of the three months of action research, the teachers in the action research group were more positive in their approach to block play, and their instruction in using block play to promote the development of spatial skills in young children had been enhanced.

4.2. Education Advice

4.2.1 Adopt Different Types of Block Play to Improve Children's Construction Skills

Young children's learning is derived from play, which is an important part of their development, and a variety of materials and toys are an indispensable medium for their growth. As a common spatial activity, block play has been widely recognized as a stimulant to children's spatial skills. The mathematical proportions embedded in blocks allow children to naturally 'discover' and 'experience' many spatial concepts and relationships as they stack and combine blocks (Mazurin, 2013). Research has shown that different types of block play can facilitate the development of spatial skills (Wu, Nian Yang, An Xi, Mao, 2021), and teachers can intersperse different types of block play into their activities according to children's interests and play experiences. For example, in mock building, teachers can select example pictures according to the age of the children and guide them to observe the details in the pictures, focusing on construction skills. In story-context building, teachers can create a meaningful context for children through lively storytelling, focusing on children's levels of thinking and problem-solving skills. In proposition building, teachers can organize discussions around the proposition and, if necessary, use multimedia and field trips to help children gain a deep understanding of the building topic, developing their creativity in the process.

4.2.2. Promote Peer Building Blocks and the Unique Value of Peer Building

Building blocks with peers has important implications for young children's development. Previous research has found gender differences in young children's mathematical abilities and spatial tasks. For example, in mathematics, high school boys are better able than girls of the same age to apply what they have learned to new contexts (Hyde, Fennema, and Lamon, 1990), and the development of peer block construction in the preschool years may help to reduce the gender differences that exist in these two areas for young children later in life. For example, Ramani (2014) et al. observed peer-to-peer block construction and their observations indicated that there were no gender differences in construction behavior or complexity. This suggests that peer-to-peer cooperation in block play may contribute to girls' levels of block construction. In addition, peer block construction also facilitates the development of language skills and problem-solving skills in young children. For example, in this study, it was observed that when children built a house among themselves to accomplish a common goal, they would communicate and negotiate around the building theme. "The house is too small; you can't build two rooms in it." One child said. "We can put it like this." Another toddler gestures with her hands. By building the blocks together, the children formed ideas about what to build, created symbolic meanings for the construction, and developed solutions to problems. And the communication between peers inevitably contributed to the development of their language skills. For example, Cohen and Uhry (2007) observed individual, two-person and small group play in a play activity area for preschool children. As expected, there was more language in pairs and small groups than when they were alone, and peers often talked about ongoing activities, past actions, or future plans. Therefore, teachers can promote block play among children through peer construction.

4.2.3. Focus on the Role of Spatial Language and Encourage Children to Communicate in It

In recent years, a number of studies have shown that young children learn mathematics not just by 'doing', but by thinking and talking about what they do (Huang, Z., Tian, F., 2015). In particular, children's output of spatial language predicts their subsequent performance in spatial tasks (Pruden et al., 2011). Related studies have also shown that young children's spatial language is significantly associated with spatial skills and levels of block construction, and that spatial language may facilitate the development of young children's spatial skills (Li, Feiyan et al., 2022). It is evident that early mathematics education in kindergarten should not only allow children to manipulate, experience and construct concepts related to space through adequate manipulation, but also encourage them to express and communicate clearly in spatial language. Because of the unique role that block-play plays in the development of young children's spatial skills, it is a good idea to use block play as a spatial activity to create an environment for children to communicate in spatial language. Children use the representational symbol system of spatial language and row blocks with their peers in block play to translate their tasks and ideas about building a house into block creations. For example, this study found through observation that children would express their thought processes through communication with each other related to the shape, size and spatial orientation of the blocks, 'to enclose it, hurry up and do it inside' children used spatial language to express their constructive ideas of building a fence to enclose a 'house' "This form of block construction represents the 'enclosed space' and the topological spatial relationship of 'inside and outside', reflecting children's topological geometric perception (Ma, 2013; Mazurin, 2013). Therefore, spatial language such as this will undoubtedly help children to perceive spatial relationships and facilitate the development of children's building blocks. Teachers can encourage children to communicate in spatial language during block play and use their use of spatial language and their level of block construction as a means of identifying their level of spatial orientation concepts and their ability to apply spatial skills.

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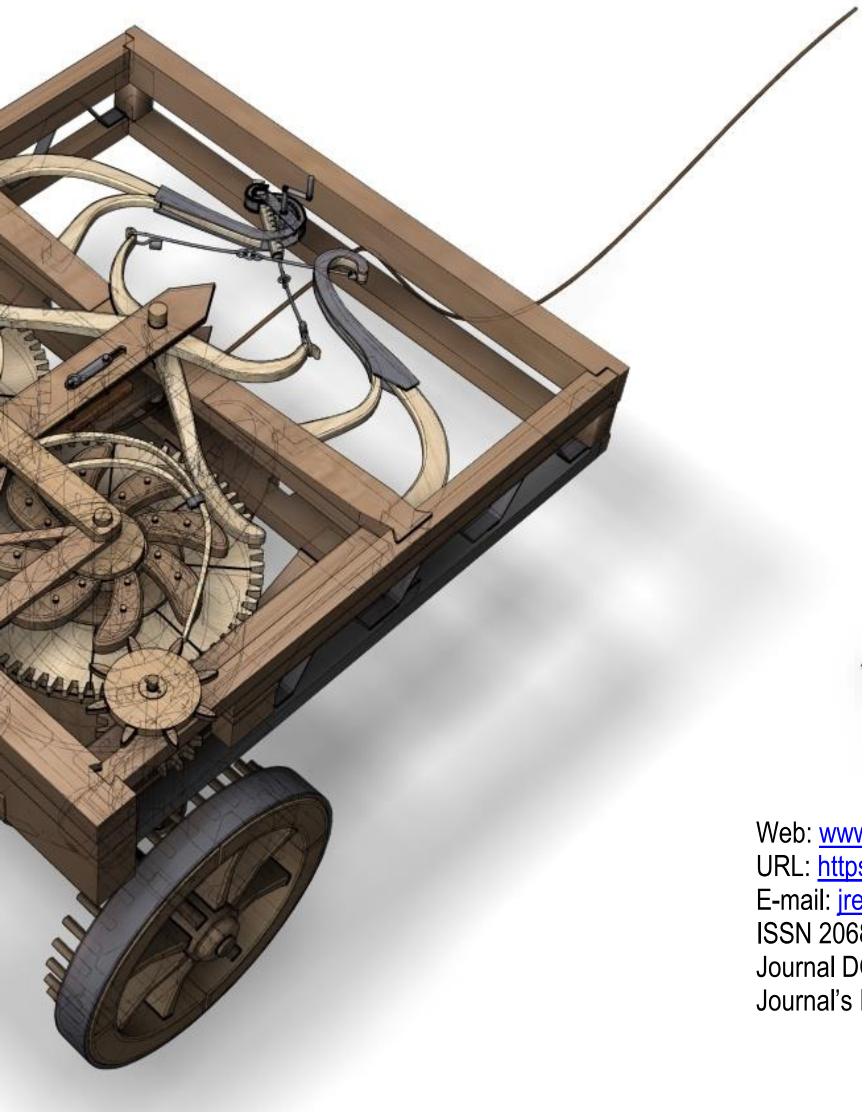

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