

Research on Teacher Roles and Learning Pathways in Young Children's Scientific Inquiry Activities —— A Case Study of the Discovery of Walnut Tree Male Flowers

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Abstract: Early years science education prioritizes nurturing children's inborn drive to explore, instead of simply delivering factual knowledge. This paper takes the walnut tree male flower inquiry activity sparked by children's spontaneous curiosity as a research case. Adopting educational narrative and in depth case analysis methods, it explores how science exploration activities unfold and deepen under child-oriented educational ideas. Research findings show preschoolers build science understanding via a repeated loop: sensory perception, active exploration, evidence checking and internalized comprehension. Teachers act as facilitators and curriculum developers, offering emotional backing, thinking-oriented prompts, curriculum planning and meaning making support throughout the whole activity. Peer groups function as a shared cognitive community, pushing children to voice their thoughts and build knowledge together through social interaction. This case unpacks how deep learning comes about: kids need to combine hands-on real world experiences with abstract ideas within the interactive "outdoor, classroom, outdoor" learning context. It supplies practical references and actionable suggestions for developing emergent science curriculum in kindergarten settings.

Keywords: preschool children's scientific exploration; emergent curriculum; teacher facilitator roles; social constructivism; deep level learning; shared cognitive community

1. Problem Statement: How Does Spontaneous Interest Lead to Deep Learning?

Within early childhood education circles, discussions about fostering children's science literacy have moved past simple arguments over whether science content should be taught or what knowledge should be covered. Practitioners now focus more on practical approaches for teaching and how young children actually learn science. China's Guidelines for the Learning and Development of Children Aged 3-6 points out that science learning for young kids aims to spark their wish to explore, let them go through inquiry procedures and lay the groundwork for basic investigative capabilities. Yet real-world kindergarten practice brings notable challenges for teachers. When children bring up random questions or show surprise toward things they spot outside during free play, how should educators respond? Poor handling may result in either superficial sensory play without real thinking, or direct knowledge indoctrination. Neither situation helps children construct their own cognitive frameworks or develop scientific minded thinking. Scholars like Liu Zhalan argue that high quality early years science education hinges on teachers' capacity to turn children's casual surprise moments into purpose driven investigation. To achieve this goal, educators must grasp how young children build cognition step by step.

This paper addresses the above mentioned practical puzzles using a real life kindergarten case: children's discovery of walnut tree male flowers. In this case, kids first noticed fuzzy green strips and tiny green balls fallen on the ground out of pure accident. With proper teacher support and group discussion among peers, they gradually built up their understanding of walnut male flowers, gaining both cognitive insights and affective experience. Through case analysis, this paper addresses three core research questions. First: what are the developmental stages and inherent patterns when preschoolers carry out self initiated science exploration? Second: how may teachers

shift from traditional knowledge oriented lecturers to facilitators and curriculum builders who support children's deep learning? Third: as a valuable educational resource, how does peer group interaction function as a shared cognitive community, and what educational value does it bring?

2. Theoretical Foundations and Analytical Framework

To interpret the educational logic hidden inside this practical case, this research draws support from constructivist learning theories and sociocultural theories as its main analytical lenses.

2.1 A Constructivist Perspective on Young Children's Learning

Piaget's theory of cognitive development states that children build their mental schemas continuously through assimilation and accommodation when engaging with surrounding environments. When children run into unfamiliar objects such as fuzzy green strips that cannot be explained by their existing life experience, cognitive conflicts emerge and break their original mental balance. Such mental disequilibrium becomes the internal motivation pushing them to start exploration. When children finally understand what male flowers are, it marks that their prior naive understandings have been adjusted and reconstructed into formal scientific concepts.

2.2 Sociocultural Theory and the Zone of Proximal Development

Vygotsky's sociocultural theory offers important theoretical grounds for understanding peer collaboration and teacher guidance. Its core concept, the zone of proximal development (ZPD), describes the gap between what a child can finish independently, and what the same child can accomplish with adult guidance or cooperation with more capable partners.

In our walnut flower case, figuring out where those fuzzy green strips came from was beyond what individual children could work out on their own. Nevertheless, after the teacher suggested children turn toward classmates for ideas, one peer named Xiaopan made a key observation, helping the whole group close this cognitive gap. This event demonstrates the social nature of knowledge construction: cognitive growth first takes place in social exchanges, and afterward gets internalized within each individual child.

2.3 Emergent Curriculum and the "Child Centered" Educational Philosophy

Emergent curriculum theory holds that teaching content is not fully pre set by teachers. Instead, learning activities grow out of daily interactions with children, responding to their questions, interests and lived experiences. Our walnut flower case perfectly illustrates this idea. The whole set of learning activities did not stem from pre written teaching plans; it grew from children's chance findings on the playground. Teachers' key responsibility lies in spotting these education worthy moments and turning them into structured, goal oriented exploration experiences.

3. Case Presentation and Analysis: A Tripartite Inquiry Cycle

This section sorts out and analyzes three successive phases within the exploration activity, showing how children's cognition develops alongside teachers' adaptive support strategies.

3.1 Stage One: Encounter and Confusion – Emergence of Individual Interest and Social Help Seeking

Event Description: During outdoor activities, children from Class Three spotted fuzzy green strips and small green balls scattered across the ground, showing great excitement. One child named YiYi brought her collected "ball babies" over to the teacher, yet she could not explain what these items were or where they had fallen from. Instead of giving straightforward answers, the teacher raised open ended questions and offered suggestive prompts: "You may go ask other children about this." The single child's personal puzzle was thus converted into a shared exploration task for the whole group.

Educational Analysis

From children's standpoint: This phase marks the starting point for developing children's science literacy. YiYi felt curious about unknown objects; she observed, touched and collected specimens, and even tried to name these new items using her existing life experience by calling them "ball babies". All these behaviors signal early stage scientific thinking. Her awkward facial expression showed inner cognitive conflict, and reflected her growing awareness of what she knew versus what she did not know. By actively showing her findings to the teacher, YiYi sought both cognitive and emotional support.

From the teacher's standpoint: The educator's response formed the core educational event in this phase. Her practice can be broken down into three dimensions. First, emotional backing: nodding affirmatively and moving closer built a safe psychological atmosphere, encouraging children to keep exploring. Second, cognitive triggering: by asking progressive questions such as "What might this be?" and "Where do you think it comes from?", the teacher guided kids to shift their observation focus from static object features toward connections between objects and their surroundings. Third, direction giving guidance: the most critical move was advising children to consult their peers. This move gave the question back to children themselves and protected their exploration process. More importantly, it introduced social dimensions into learning and offered workable solutions for limits in individual cognition, matching Vygotsky's scaffolding ideas. The teacher chose not to directly deliver answers, and this deliberate restraint laid the foundation for higher level growth in children's cognition and social skills.

3.2 Stage Two: Cooperation and Breakthrough – The Power of the "Cognitive Community"

Event Description: Following the teacher's suggestion, YiYi turned to peers including Momo for answers. Even though Momo could not solve the puzzle, their decision to search together expanded the exploration from individual work to group collaboration. After consulting several classmates, Xiaopan chose to look upward toward tree branches. He spotted the source of those green strips, and the whole group verified this discovery together, cheering out of excitement.

Educational Analysis

From children's standpoint: This phase vividly shows the power of peer groups acting as a shared cognitive community. Social interaction deepened: YiYi accepted the strategy of asking peers for ideas, shifting from personal confusion to group oriented problem solving. Group thinking brought breakthrough insights: Xiaopan's upward looking behavior represented a small instance of scientific reasoning, combining guesswork, inference and real world checking. While other children paid attention only to items lying on the ground (the outcome), Xiaopan traced back toward the source (the cause). The whole group quickly accepted his finding, because all children could see the evidence with their own eyes; knowledge was therefore verified and shared collectively. The children's joyful jumping reflected the sense of intellectual satisfaction brought by sudden insights. Such positive internal rewards from self directed discovery strongly motivate children to maintain active learning attitudes.

From a theoretical perspective: This case exemplifies social constructivism principles. Vygotsky's zone of proximal development is well reflected here. The teacher supplied broad range scaffolding by encouraging peer consultation, while classmate Xiaopan provided micro level scaffolding. His observation helped the entire group cross over cognitive barriers. Knowledge about where fuzzy green strips originated was built through group communication, rather than passed on by teachers in one way fashion. This case also reminds educators that teachers' proper withdrawal carries equal importance to active participation. When peer collaboration works effectively, teachers' quiet backing off respects children's agency and creates space for the cognitive community to function naturally.

3.3 Stage Three: Elevation and Internalization – Anchoring Concepts and the Cycle of Meaning

Event Description: The teacher brought collected specimens back into the classroom and organized collective learning activities following the sequence: observation, hypothesis making, analysis and video based verification. Through these arrangements, children came to understand that those fuzzy green strips were walnut tree male flowers. They also gained basic knowledge about their life cycle: male flowers drop off after pollination, and female flowers will then grow into walnuts. Later, the teacher led children back under walnut trees once more. Through this second round field observation, children deepened their understanding and emotional perceptions.

Educational Analysis

From children's standpoint: Children achieved important cognitive advancement in this stage. First, they moved from informal pre concepts to formal scientific concepts, linking what they sensed as fuzzy green strips to the formal term "male flowers". Second, they progressed from merely knowing facts to understanding underlying mechanisms, grasping pollination functions and fruit forming purposes. Their mental schemas underwent structural adjustment. Returning to natural outdoor sites held special educational value. Abstract concepts about male flowers were connected to real world scenes, enabling embodied cognition and affective internalization. The first time children looked at walnut trees, they were driven by simple curiosity; the second time they observed with comprehension. Knowledge merged with real settings and multi sensory experience, becoming vivid and impressive.

From the teacher's standpoint: The teacher showed multiple core roles in this phase. As curriculum developer, she transformed random outdoor incidents into systematic teaching activities matching children's cognitive features. As mentor for scientific thinking, she designed the observation hypothesis analysis verification workflow. Such arrangements subtly delivered basic inquiry modes; the goal was not just knowledge acquisition, but helping children learn how to think and explore. As meaning builder, she built a cyclic learning path: outdoor nature → classroom → outdoor nature. She broke spatial limits for learning, letting direct real world experience and abstract knowledge reinforce each other continuously. This practice echoes Dewey's viewpoint: education represents continuous reorganization of personal experience.

4. Discussion: Educational Implications for Deep Learning

This walnut flower case is far more than a simple nature story. It records how young children learn and how teachers offer proper support, and delivers valuable theoretical and practical enlightenment.

4.1 Returning to the Cognitive Origin: Valuing the Complete Cycle of "Perception–Theory–Re perception"

Deep learning does not end once children receive standard answers. Effective science exploration should follow a complete cognitive cycle. It starts with children's direct sensory perceptions and informal understandings formed in real life contexts, for instance their impressions of fuzzy green strips. Next, guided by teaching interventions, sensory experience develops into rational thinking and scientific concepts such as male flower knowledge. The final critical step (which also serves as a new starting point) is re perception: children go back to real world contexts, applying newly acquired knowledge for verification and practice. In this way, knowledge gets personalized and meaning is fully constructed. If educational practice skips the re perception link, learned knowledge will become disconnected from reality. Children cannot flexibly apply such rootless knowledge in real scenarios.

4.2 Reshaping Teacher Roles: From "Classroom Dominator" to "Versatile Role Performer"

This research sorts out multiple constructive roles teachers should take during children's in depth exploration. On the emotional dimension, teachers act as supporters, protecting children's curiosity through positive attention. On cognition strategy dimension, teachers serve as guides.

Instead of directly telling answers, they use high level questions to stimulate thinking and guide children to make use of peer resources. On curriculum dimension, they become curriculum designers and developers, turning random daily events into structured learning content. On meaning construction dimension, they connect knowledge with daily life, bridging classroom study and natural environments. These responsibilities set high professional requirements for kindergarten teachers. Educators need sharp sensitivity toward educational opportunities, solid curriculum design logic, and self restraint: they ought to hold back the impulse to deliver ready made knowledge and patiently wait for children to complete their own exploration.

4.3 Revaluing Peer Value: Cultivating the "Cognitive Community" Intentionally

This case fully demonstrates peers' value as educational resources. Peer communication brings emotional resonance, and also serves as key driving force for cognitive advancement. In chains of questioning, searching, discovering and cross checking, children achieved cognitive breakthroughs hard to realize by individual work alone. For educators, this means we should consciously build environments and group culture supportive of joint exploration. Concrete measures include designing cooperative tasks, reserving space for group discussion, and fostering children's habits of listening and considering others' viewpoints. Teachers ought to cultivate such shared cognitive communities, rather than only focusing on knowledge delivery.

4.4 Building Flexible Curricula: Let Learning Breathe Between "Prescription" and "Emergence"

The walnut flower case serves as a typical example of emergent curriculum practice. It shows that the most vibrant learning often grows out of unexpected real life moments. This does not mean teachers should adopt completely passive attitudes, nor does it deny the value of pre planned curriculum arrangements. Teachers' professional wisdom lies in dual capacities: spotting educational value from children's casual interests, and quickly mobilizing professional competence to integrate these spontaneous interests into structured, goal oriented teaching frameworks. High quality curriculum pursues dynamic balance between preset educational objectives and children's real time interests, so that learning gains flexibility and vitality from real life situations.

5. Conclusion

Those fuzzy green strips that children named casually sparked rich life science learning. Supported by thoughtful teacher guidance and peer group collaboration, simple natural observations grew into profound learning experiences. Analysis of this case reveals: preschool science exploration is essentially a meaning construction journey from initial curiosity toward real understanding. During this process, teachers step down from authoritative knowledge giver positions, and turn into learning designers, learning companions and meaning connectors. Learning spaces shift flexibly between classrooms and outdoor nature. Scattered sensory impressions evolve into structured scientific concepts, and finally return to children's real world understanding with emotional warmth. This case illustrates the core pursuit of high quality early years science education. It is not about explaining the world to children, but providing proper tools, environments and peer partners. With these supports, children can explore independently, share ideas with others, experience the joy of discovery and feel the value of thinking as little scientists.

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