EXPERIENCING INQUIRY WITH KINDERGARTEN: SCIENCE FOR KIDS

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ABSTRACT: Inquiry is not just about motivating children by providing them with hands-on activities but also help children to acquire with the required skills for observing, questioning, predicting, communicating, verifying the predictions, reflecting ideas with evidences, and making logical explanations. Even though many research is available for supporting these skills there has been some doubted on how to fit in inquiry skills with the age group 4-6. Therefore, this study aims developing inquiry framework through authentic activities with kindergarten children ages 4-6 (n=45). The frame of the activities is starting with a real problem such as "Have all the stones sink?", and then children discuss the issues by predicting. On the next level teacher encourage them to build observation, experiment and data-handling. Finally, they report and reflect what they discover through their evidence by working collaboratively with others and communicating their own ideas and considering others' ideas. During the program, sequential inquiry activities on different subjects were settled and performed at least 3 hours for 14 weeks. The techniques, which aims to record results obtained by illiterate preschoolers, of cutting gluing worksheets, drama, sheets of stickers, process of creating art products, picture completion, counting and scale measuring, matching, patterns, puzzles were used as worksheets and tools for data handling. During the process children's representing of their results in various techniques and their reasoning patterns was progressively supported. Over the time the activities help them to deepen understanding of being curious about daily issues in a questionable manner, inspiring an interest about science, verifying explanations or predictions with results, and verbalizing ideas about their experiences.

Key words: Inquiry learning, kindergarten, data-handling, observation, science activities

INTRODUCTION

In terms of the nutrition experts' kids do not eat food, they only eat snacks. Thus, in early ages the conflict between the parents and the children start with the eating habits. When it comes to the school ages, kids do not learn as the adults say, they only be curios and discover, since if there are no curios and discover it means there is no enthusiasm. On the other hand, discovery and enthusiasm could not happen by sitting around a desk like the teachers want in school years. Subsequently, there will be not enough room for fun. Against all odds if the teachers force to put the information into the student's head, the conflict, withdrawal and loss of confidence activate in children. So, we educators might be better to inquiry and interpret our training again.

Inquiry oriented science education capitalizes on natural curiosity of children. Inquiry focuses on doing rather than acquiring. On the other hand, it is not just about motivating children by engaging them in hands-on activities (Finley & Pocoví, 2000; Minstrell & van Zee, 2000; Wheeler, 2000). Inquiry encourages children to construct knowledge in ways that are meaningful to them (e.g., Bruner, J. S., 1965; Edwards, C., Gandini, L., and Forman, G., 1998; Byrne, J., Rietdijk, W., and Cheek, S., 2016; Metz, K., 1995; Martin, R., Sexton, C., Franklin T., & Gerlovich, J. (2005).; Tyler, R. and Peterson, S., 2004).

The key element of teaching science as inquiry is to allow time for children to engage in dialogue with the material world by observing, questioning, predicting, debating, reflecting on data evidence, and make logical sense of their observations in a structured manner (Alberts, 2000; Artigue, et al., 2010; Crawford, 2009; National Research Council, NRC, 1996; Wheeler, 2000). Thus, the children will be engaged physically, mentally and socially not only scientific knowledge but also what it means to do science.

METHODS

Description of the Study

This study aims developing inquiry framework through authentic activities with pre-school students ages 4-6 (n=45). The frame of the activities is starting with a real problem such as “Have all the stones sink?”, and then children discuss the issues by predicting. On the next level teacher encourage them to build observation, experiment and data-handling. Finally, they report and reflect what they discover through their evidence by working collaboratively with others and communicating their own ideas and considering others’ ideas. During the program, sequential inquiry activities on different subjects were settled and performed at least 3 hours for each week which takes 14 weeks during the autumn and spring semesters. Sport, art and technology such as children games, stories, poems, songs, drama, gymnastic, painting, matchup, puzzles, classification and so on were used as a tool for data-handling since they illiterate.

The researchers used observation notes and the children’ worksheets as tools in understanding the degree of effectiveness of the activities and the students’ reflection to the inquiry based learning. Researcher notes are notes that reflect the researcher's own observations and sometimes the researcher's reactions (Yıldırım & Şimşek, 2006). Right after the class the three researchers come together around the round table and discuss their notes in terms of the questions *“What we have learned from this week? What should have us add more? How was the children’s reaction to the activity? Were the children able to make connections to their everyday life?*" and etc.” Three researchers one of them is instructor took observation notes. Two of the observers who are PhD students on science education collected data as indirect observation throughout the implementation.

The Role of the Teacher during the Study

The role of the inquiry teacher in the classroom is not putting the knowledge into the student’s head. The teachers by themselves have to open learning with their students. The inquiry teachers just accompany their students during the learning process by bridging with them an empathy without prejudge. The teachers themselves improve with their students.

How you are positioned in the classroom is very vital. If the position of the teacher is standing in front of the classroom, it should be very frightening for the small kids. Instead locating with the same level of the students for instance, if the students are sitting the teacher is better to sit next to them or if they are standing the teacher is better to locate near them doing the activities cooperatively and collaboratively would be better for children and also the teacher. The classroom atmosphere ought to be comfortable and friendly for kids (see Figure 1).

Figure 1. The inquiry classroom atmosphere

During the study, each week the teacher came to the classroom with a question. In some cases, she shares a problem from her laboratory and asks for help or she expresses one of her new activity and asks for to evaluate it. Bridging an intellectual and emotional intimacy with the children is very important. Theatrical expression, approaching with games and giving them roles are always help to catch their attention.

Expecting always the best from the children decreases their self-confidence. The inquiry teacher encourages their students to reflect by giving value to their ideas. There is no true or false idea in inquiry classroom. All thoughts are valuable. This is very important for introvert children since for a while they also finding courage to share their ideas. In close future, the students’ ideas evolved better and a rich argument area is formed in learning context.

The Inquiry Activities

Inquiry based activities carried out in three stages accompanied by worksheets. The first stages of the worksheets help children to reflect their predictions with different techniques. The second stages ask children to state or keep their recordings to observations or experimental results. And the final stages aim verification which included comparison predictions and evidences (i.e. the results of the experiments) (see Figure 2).

Figure 2. Sample of activity worksheets

Float or Sink

Float and Sink activity caries out investigating floating and sink conditions of different kind of stones based on "Do all stones sink?" question. The students classify stone sapmles by observing and record their data with cut-and-paste technique used as data collection tool (see Figure 3).

Figure 3. Float and sink

Magnets

This activity consists of four game oriented activities; invention of the magnets, flying magnets, magnet detectors and magnets on the gift packs. In the first part of the activity, each child is given a bar magnet and a horseshoe magnet to let them do experiments on the interactions between magnets and interaction of magnets with other objects (see Figure 4).

Figure 4. Children experience the magnets

In the second part of the activity, children apply pressure to the circle magnets hovering on each other in a cylinder. In that way, they can understand magnetic attraction and repulsion features better (see Figure 5).

Figure 5. Magnetic attraction and repulsion

In the third part of the activity, children are asked to stick their stickers on objects in accordance with the objects' interactions with the magnets. In that way, all the objects in the classroom are classified as "affected by the magnets" and "not affected by the magnets" (see Figure 6).

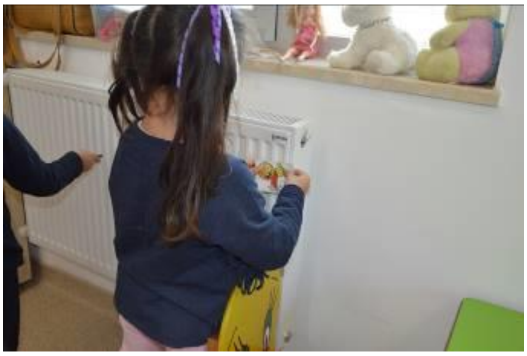

Figure 6. Magnet stickers

In the last part of the activity, gift packs are prepared, 1 pack involves a magnet, 2 packs involve iron and 2 packs involve glass/wooden objects. Children were asked to find the gift magnet without opening the packs (see Figure 7). What is important in this activity is to find which one is iron and which one is magnet when two gift packs attract each other. Finally, children design magnets as an art activity.

Figure 7. Find the gift magnet

Existence of Air

In this activity, children collect evidence on the existence of air, the matter that surrounds us. A child blows a nylon bag by blowing into it 5 times. Another child swings a nylon bag in the air and knits it quickly. Inflated bags are compared. Gathered data are recorded as picture completion activity (see Figure 8).

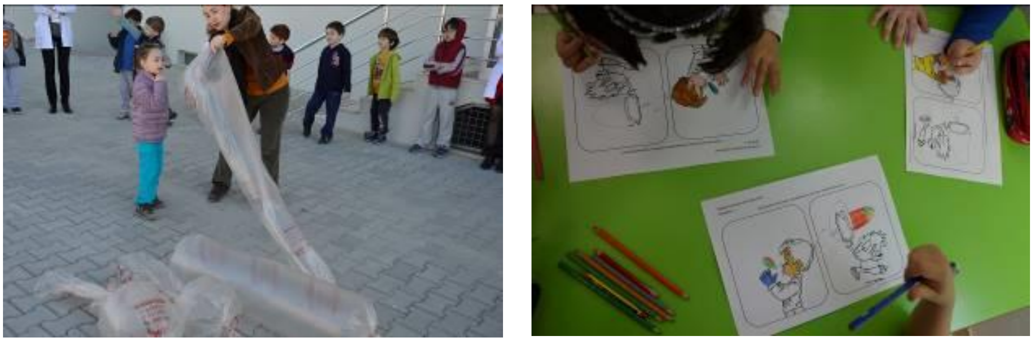

Figure 8. Existence of air

In another activity, children measure the distance made by their air rocked they prepared with balloons and record those on their worksheets (see Figure 9).

Figure 9. Air rockets and worksheets

After that, a drum-like big plastic bucket is prepared by cutting off the bottom and covering it with a flexible material. Candles are snuffed or paper cups are knocked off by hitting the flexible side of the drum right opposite to them. Children get as many stickers as the number of knocked off cups (see Figure 10).

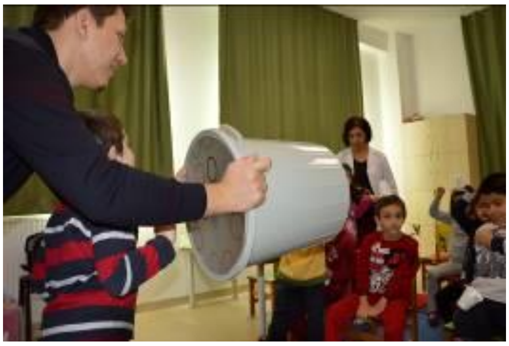

Figure 10. A drum-like big plastic bucket

Children prove the existence of air by touching, feeling and measuring. Finally, children are given a water-filled bowl, upper part of a plastic bottle, bottle cap and two jelly tots on top of little candle containers. Children are asked to find how to dive the jelly tots in the bowl without getting wet. In the preparation process, a cup (with cotton in its bottom) is submerged upside down in the water filled bowl. The data is gathered using labyrinth puzzle technique (see Figure 11).

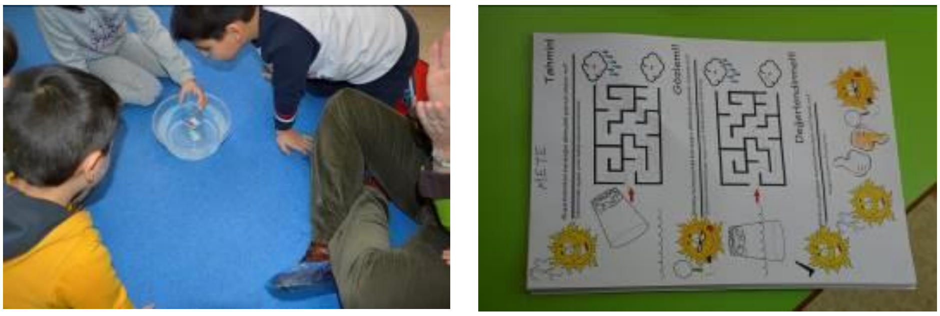

Figure 11. Labyrinth puzzle technique and existence of air

What Color is My Apple?

Teachers developed a new discourse “Be creative!” in pre-school level to promote their students’ creativity. However, these verbal expressions are not enough to enhance creativity. Individuals must think out of the ordinary to be creative. This can be achieved by experiencing different situations, determining the variables and manipulating these variables. For example, in order to say “be creative, paint different colored apples” to a student who is drawing apples; teacher must let the students experience at the first hand that apples can be in different colors depending on the light and apple’s pigments. This thought is the groundwork for this activity. Red, green and yellow apples, bought from the market, are observed under red, blue and green light (see Figure 12). Painting is the data collection tool. Pre-and post experiment observations are recorded by painting colorless pictures of apples.

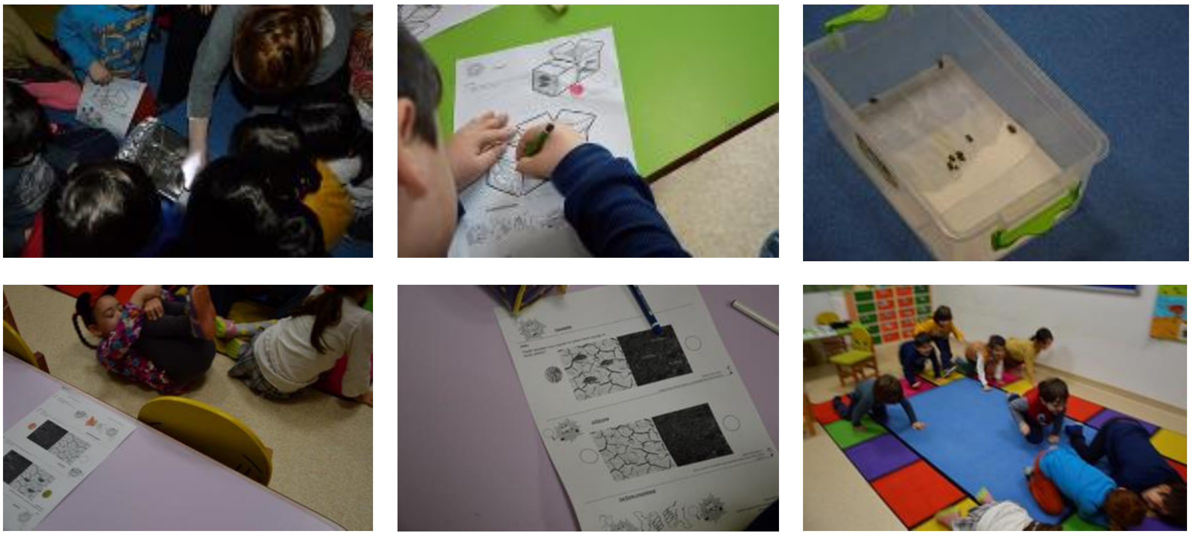

Figure 12. What color is my apple

Plants Like Water

In this activity, the students observe colors which are result of distribution and mixture of different colors and how a plant carries water to its leaves. The children cut papers in daisy shapes which were drawn in advance. Then they draw some dots on the leaves of paper flowers with marking pen and fold the leaves. After this, they put the paper flowers on a cup filled with water and start observing it. They use main motor skills such as cutting, folding, painting and drawing as data collection method with this activity (see Figure 13).

Figure 13. Plants like water

States of Matter

In this activity, the children change of the matter from solid state to liquid and gaseous state. They repeat the transformation process from solid state to gaseous state and gaseous state to solid state of matter. They use pattern technique as data collection method. Transforming water vapor into liquid is an interesting observation for the children (see Figure 14). Then, they discuss about states (solid or liquid) of an oobleck substance made of water and starch.

Figure 14. States of water

Beak Activity

The purpose of this activity is investigating the adaptation of living creatures. The investigation is carried out with a systematic process. The worksheets are prepared based on this order. Children are expected to make predictions according to research question. They ought to design an experiment with variables related to predictions and conduct the experiment based on the worksheets. Then they are expected to compare results of the experiment and their predictions in the beginning. Before the activity, students watch the tale of the fox and the stork or the story is told. Then the students are given a tablespoon and a pair of sticks or latches randomly. Food (coins, toothpicks or broken spaghetti sticks and marbles) is spread on the floor. Then children try to collect their food with beak models into plastic cups. They keep record of their data by painting boxes of bar graphs (see Figure 15).

Figure 15. Beak activity

Observation of Pill Bugs (Armadillidiidae)

In this observation-based activity which includes supporting thinking with variables, the children study on a crustacean living creature (*Armadillidiidae*) called as pill bug or ball bug in colloquial speech. Students investigate common environmental factors about these creatures by collecting data, picturing, designing an object and preparing observation report (Oguz, 2007). First, children observe these creatures with magnifying glasses and draw their observations (see Figure 16). During this process, teacher helps them to detail the observation with some questions such as “Do they have antenna? How many feet do they have? Do they have knots?”. The similar and different features of these creatures are put forth during the observation.

Figure 16. Observing pill bugs

Then the experiments are designed and conducted about habitable environments of these creatures (see Figure 17). They record data with comparing and drawing techniques in predicting, observing and evaluating processes during activity.

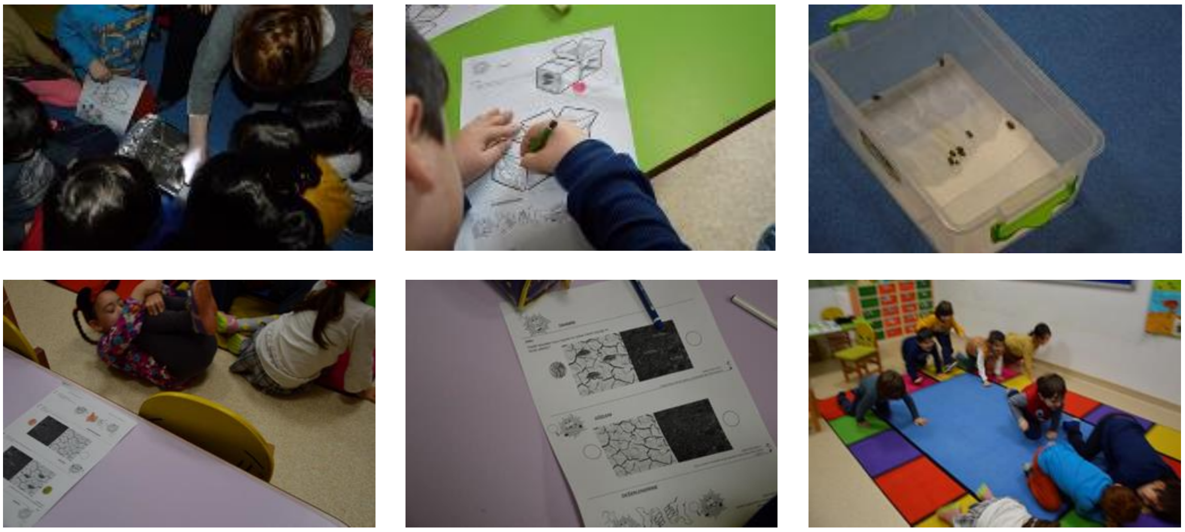

Figure 17. Pill bugs habitat

RESULTS AND FINDINGS

In inquiry-based science practices of early childhood education, one of the difficulties of teaching through the evidences is to develop worksheets which are used by children who are illiterate (Burts, Hart, Charlesworth, & Kirk, 1990; Grossman, 1996; Marr, Cermak, Cohn, & Henderson, 2003; Wien, 2002). The techniques developed during the activities of the research allow children to record their evidences such as cutting gluing worksheets, drama, sheets of stickers, process of creating art products, picture completion, counting and scale measuring, matching, patterns, puzzles ext. has eliminated this problem.

During the inquiry, the questioning of the students is also directed from closed questions which have one correct answer to reasoning questions which are answered with arguments or reasons. For example, the questions of "*Is this bird eat grass?"*, "*Is there any offspring of this bird?"* give way to the reasoning questions of *"Why the beaks of birds are different from each other?"*

If inquiry is converted into 1-2 hours of demonstration activity, that kind of practices as an inquiry has no validity and reliability. Typically, amazing experiments in which higher visuality is presented in the form of demonstrations and children's attention is aimed to be taken. The pictures of the children staring in amazement are taken and shared in social media. This must be one of the most common situations that we currently encountered. However, a certain time of period should be spent for the children to feel comfortable in inquiry practices. It is claimed to be that the biggest challenge working with small children is their inability to abstract thinking. Therefore, science topics are considered to be inappropriate to the thinking of the children. The children to explain an idea by associating with something that is not there or with a phenomenon shows evidence of abstract thinking. For example, in the activity related to the existence of air, one child claims that we cannot see but we can hear the sounds during the phone conversations. During the beak activity, another child argues that the teeth of creatures are different and elephants, crocodiles, and other animals can be given as the examples for that. And one another child also claims that we cannot see the power of magnets but we can feel it. As a result, establishing the relationships between topics is the valid arguments for children's inquiry. A one higher level of that is for child to creating a new product with these relations.

It is observed that inquiry has an effective role in the language skills of children. In the activities, it is determined for the children using the words of *thing* instead of *objects* or *items*, *feed* instead of *what it eats*, *cloud* instead of *water vapor*, *push-sticking* instead of *push-pull*; *pattern* instead of *cycle.* The children learned how to use those words correctly within the process of inquiry. In course of time, children understood that their knowledge is dynamic and changeable. For example, after the floating and sinking activity, one child has commented as *"I have believed that formerly all the stones sink but after that I know that some are floating"*.

Children like the usage of different kinds of presentation techniques. In particular, screen and visuals are very important to them. Therefore, a cartoon telling the tale of the fox and the stork was used for the beak activity. Similarly, it was benefited from documentaries in some activities. For example, in the activity named all plants like water, children were very impressed by observing a flower how to be out in a slow motion.

The questions are asked children to encourage inquiry, for example: *"What would you like to explain/say me with this?".* However, some children may prefer remaining nonspeaking. If their friend launches forth upon something, the child who is nonspeaking encouraging by his/her friend can start to communicate about the topic. Meanwhile, when the teacher asked the question of *"How do you know that?"*, they started to query about what they never query before and to think about where their knowledge came from.

Children's ideas always need to be listening. When we asked randomly a boy *"what do you think about when a pillbug closing?*" while we have focused on inquiry with the idea that we should guide the activity appropriately, the boy suddenly threw himself on the carpet and twisted like a pillbug, and closed himself. The message implicitly sending us is that they closed like me when they are scared away. This is the strong argument to show inarguably paying attention to their ideas.

Inquiry allows children to think, to ask questions and to put forward their thoughts. Children can express themselves in different ways. The evaluation practices do not need to be in the form of standing up and saying or writing that we practice mostly in current school climate.

CONCLUSION AND RECOMMENDATIONS

Consequently, it is very important to present a current issue as questionable way into children. If the teacher would like to create an effective discussion atmosphere with broad participation, putting children's daily life in the center of activities might be a solution. But here teacher has a responsibility for ensuring the balance, because there are no reservations and limits of children's behaviors. They can ask whatever they want.

Children have curiosity from the birth. There is no need to think abstract for making sense of life. It is important to emphasize the experiential ones. Increasing the child's imagination means improving the creativity. We need to expand our lives with our experiences. Educational activities should be activated. Therefore, it is important for educational activities to be taken into account. Highlighting this point for child as communication and stimulating this together help to bring curiosity into the open.

Consequently, our main purpose is to bring children together with science and to inspire an interest in science as opposed to the idea of providing the scientific concepts. We were able to continue the interest with these kinds of activities.

The observation range should be longer for students, because they need a time to distinguish one thing from the other within their wide inner world. During the activities, the use of the combination of both the motor skills and the operation of mental functions increase the children's recall and retention. If children are more aware of what is happening their around, they can be more intensely in the moment and they can jog the more their own memory.

Prediction practices are important for children to allow their self-evaluation, to associate their predictions with their experiment results, and to generate their own knowledge. We need to ask questions not because of asking question and getting answers but because of arousing curiosity. All these evidences give us hope to be made inquiry based practices with kindergarten children.

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