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Exploring Children's Science and Mathematics Ability with Leaf Diary: A Case Study

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Abstract

Purpose – This study aims to explore Leaf diary activity to develop the Science and Mathematics ability of children aged 6 years.
Design/methods/approach – The method used is a case study. The unit of analysis is based on predetermined criteria, using the purposive sampling technique. Research informants are mentors and children involved in leaf diary activity in Solok, Indonesia. The data collection process used participant observation, documentation, and in-depth interviews. Data analysis used structural analysis techniques.
Findings – The results showed that leaf diary activity could develop: (1) children's ability to classify leaves based on their shape; (2) the ability to compare leaf size based on length, as well as large or small size.
Research implications/limitations – All research informants were from Solok District, Indonesia, which may limit the generalizability of the findings.
Practical implications – This case study contributes to the implementation of Leaf diary as an alternative activity that teachers or parents can do to develop children's science and mathematics ability.
Originality/value – Leaf diary activity can help children explore the natural environment so that basic science and math abilities and concepts in this activity are carried out well.

Keywords Leaf diary, Early childhood education, Science and mathematic

Paper type Case study

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1. Introduction

The COVID-19 pandemic affects all human activities, including education (Pramana, 2020; Roza, 2012; Saepudin, 2011; Sapriati, 2013). Educational activities carried out face-to-face have been replaced by online learning, which is carried out from home. The online learning policy aims to minimize the spread of COVID-19. Learning from home applies to the higher education level and at the primary level, including early childhood education (Fardiah et al., 2019; Nurdin & Anhusadar, 2020; Retnaningrum, 2016).

This policy creates obstacles in implementing early childhood learning, emphasizing play activities. The concept of playing while learning is difficult to implement because the learning process runs online. Educators also find it difficult to design lessons presented to children during online learning (Lee, 2020). The learning and teaching process that was previously carried out face-to-face and physical activity to achieve all aspects of development has now turned into online learning, which no longer involves children's activities to interact directly. Therefore, many presented online learning activities are not on target.

In addition, parental assistance is less effective because unstable psychological factors are difficult in online learning. This is because parents have to share roles with their daily activities. If this condition continues, it will affect optimal child development (Fardiah et al., 2019; Nurhafizah, 2017; Suastra, 2010). Another obstacle experienced in applying online learning for early childhood is the lack of parents' pedagogical abilities. Thus, parents often complain while accompanying their children's learning.

The above problems clearly show that simultaneous online learning is not optimal in instilling various developing aspects (Pramana, 2020; Retnaningrum, 2016; Roza, 2012). Therefore, if this condition continues, the formulated material content and learning objectives will not be achieved. This triggers the loss of initial foundation and readiness to continue education in the future, especially in entering the next level of education (Hewi & Asnawati, 2020; Marwiyati & Istiningsih, 2020; Siregar et al., 2020). Therefore, it is necessary to find a solution to this problem immediately. The best action that can be a solution for teachers and parents to take to ensure the continuity of the environmentally friendly and safe from the coronavirus teaching and learning process is by using a leaf diary. Leaf diary is a play activity that utilizes the surrounding environment to play and recognize leaf shapes. Thus, it is very easy for teachers and parents to do at home.

This study aims to explore Leaf diary activity to develop the science and mathematics ability of children aged 6 years. Leaf diary activity can be done in any environment that allows children to find different types of leaves. Learning that can provide children with exploration is important so that it becomes one of the solutions in optimizing aspects of children's development through fun activities. Therefore, this study is important as a reference for educators or parents in carrying out child-friendly home learning during the pandemic.

2. Methods

The method used is qualitative with the type of case study. This type was chosen to comprehensively describe the reality of the actual situation to obtain accurate data, especially related to leaf diary activity or the activity in developing classification and comparing abilities of children in their early childhood. Research informants in this study were selected based on predetermined criteria. Thus, selecting informants in this study used a purposive sampling technique. In this case, the research informants were mentors who facilitated leaf diary activity and children involved in these activities.

This study was conducted in Salayo, Kubung District, Solok Regency, West Sumatra, Indonesia. The subjects of this study consisted of kindergarten-age children and mentors in the online learning process. The researchers' data collection process consisted of three ways, i.e., observation in participant observation, documentation, and in-depth interviews to obtain more complete data. Observations were made to observe the activity process and the mentoring process for children when participating in leaf diary activity to obtain detailed and accurate observation

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data. Interviews were conducted with research informants, i.e., mentors and children involved in leaf diary activity. In this study, the structural analysis technique became the researcher's choice according to the characteristics of the research objective. Structural analysis is the process of examining case study data to identify patterns inherent in discourses, texts, events, or other phenomena.

3. Result

The study's findings conducted in Nagari Salayo, Kubung District, Solok Regency, found that the leaf diary activity during the COVID-19 Pandemic was done by collecting various types of leaves around the children's residence to be attached to their designated books. In this study, activities were carried out in harvested rice fields. The activity begins with an opening to attract children's interest and explore children's knowledge about leaves. After these children have shown their interest, the mentor challenges them to collect as many leaves as they can find by collecting them in their respective leaf baskets. The children will then run around in the fields and bunds and observe and collect various shapes of leaves. After the given time for collecting the leaves ends, the children will return to the mentor and show the results of the leaves they have collected. The mentor then invites the children to pay attention to the leaves they have collected, and the children are asked to explain the difference between each leaf. The activity continued by classifying leaves based on certain criteria, such as shape and color. After the children were accompanied to classify the leaves, they were given a book and glue to stick the leaves they had classified. The activity is then closed with a conclusion. In the closing activity, the mentor asked about what the children had done and provided reinforcement that the children had done comparing and classifying activities.

This activity is full of meaning and value in developing children's basic science and mathematics ability, oriented towards fine motor development. This description is illustrated in a snippet of the interview results obtained from the main informant. This is as stated by the informant RY.

> *"This activity utilizes nature for children's learning activities, so there is no need to be confused. The benefits are quite a lot, it is cheap, environmentally friendly, and the children are happy for sure, take a look at that. They love to collect the kinds of leaves they find around them."* (WW/01)

The leaf diary activity is one of the playing concepts while learning in an early childhood learning culture. This means that the children look happy in this activity and enjoy the activities arranged by the mentor in the learning process from home. Not only that, leaf diary activity indirectly provides an opportunity to explore nature close to daily life more closely. This is in line with the findings of the researcher's field notes that

> *"The children seemed happy in finding and picking the leaves of plants that were around the neighborhood near their house. They look enthusiastic plucking while jogging accompanied by laughter."* (CL/02)

The description of children's enjoyment when carrying out leaf diary activity was also recorded in the interviews and interview recordings conducted by researchers when observing the performed activities. The interviews showed that the children were very happy with this activity because it was interesting and made them curious. This is a very fun activity at the stage of learning from home. These are as told by ER and VN.

> *"Happy… yes… happy…. Umm can tell the leaf, uh… what was that, the shape of the leaf". Can play... look for leaves... Mom said later they will be collected in a picture book, then pasted on... It is cool… uh, yeah… it is fun."* (WW/03, WW/04)

From the narratives of various sources as described above, it is clear that the leaf diary activity is one of the most enjoyable learning activities from home for children. This activity can make children know nature better and recognize the various leaves in their surrounding

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environment. Children can learn to recognize and practice classifying the similarities or differences in the types of leaves found. Therefore, in this activity, there are essentially two trained abilities. This is as explained by RY as a mentor who participated in this activity:

> "*There are basic science and mathematics ability in Early Childhood, right, so if we think about it, what are the activities? I thought, why don't we just use nature to study? Sometimes, children do not see it on YouTube, but it is interesting to watch other videos, right? That is how it is. So yes, the purpose of classification… erm... classification ability is the same as comparing. Later, the child will stick their findings on their drawing book, then we ask them which one is longer, and then the children group the leaves that are finger-shaped... like that,,,,"* (WW/05)

As explained above, the concept of the leaf diary activity is a process of training children in classifying the types of matching leaves or are the same as other leaves, especially from the physical characteristics that children find. Another concept offered in this activity is to train children in comparing the size of objects in the form of lengths measured by one leaf with another. This activity is also illustrated in a field note that the researcher wrote while making observations.

> *"When they finished collecting, the mentor asked which plant leaf was the longest; then the children chose the longest leaf. Then the mentor asked to stick it to their drawing book. After that, it was seen that the children arranged the leaves according to their size, from the largest to the smallest, and then they glued them. They did the same with leaves with the same physical shape; the child collected them and then attached them to their drawing book. They put it on a sheet of paper and glued it."* (CL/07).

The informant also stated the same thing regarding the content of the leaf diary activity. They stated that this activity focuses on the two basic abilities of science and mathematics and supports motoric development for children. These results are illustrated by the two statements when the researcher conducted the following interviews with RY as the informant.

> *"Uhm… what is that? That is not all, fine motor skills too. Because of this, this activity is training for basic skills, such as sorting, matching the same object, collecting the same object, continuing to sort it, like for example, there is an object, and the child is asked to see which one is longer or shorter, just like that."* (WW/06 dan WW/08)

On another occasion, the results of the activity documentation also showed the same thing, that the leaf diary activity openly fulfilled two important points in training basic science and mathematics ability for early childhood. This can be seen at the stage after the children collected the leaves in a basket, then they explained the differences and similarities of each leaf they found. For example, some leaves have the same colour but different shapes, the child finds similarities and differences, the child then classifies the leaves based on the criteria asked by the mentor. The leaf diary activity implementation description shows that two abilities are trained in this activity, i.e., (1) The ability to classify and (2) the ability to compare the length of objects. This confirms that the leaf diary activity is effective for training classification skills at the basic science level in early childhood and is effective in training the ability to compare object lengths. This is presented in the figure 1.

Based on the findings above, leaf diary activity is possible in practising basic science and mathematics ability in early childhood. This ability does not rule out the possibility at children's fine and gross motor development levels. All aspects of child development are accommodated in this activity. In addition, the following two important points can be seen, both from the results of documentation, interviews, and observations made: it appears that the abilities to classify and compare are the most dominant abilities seen in this activity. Thus, the leaf diary activity is one of the activities during the pandemic that can be used as an alternative for learning activities at home to accommodate and train children's classification and comparison abilities.

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(a) (b)

Figure 1. (a) Children Stick the Leaves of the Same Shape on Their Drawing Book (b) Children Compare Leaves from the Longest to the Shortest

The description of the analysis results from several data collection processes that have been performed shows that there are two most dominant activities in leaf diary activity, as seen in the coding in the circle with the KK (classification ability) and KM (comparing ability) codes on the three data collection techniques, i.e., interviews, observation, and documentation. This is shown in the following image:

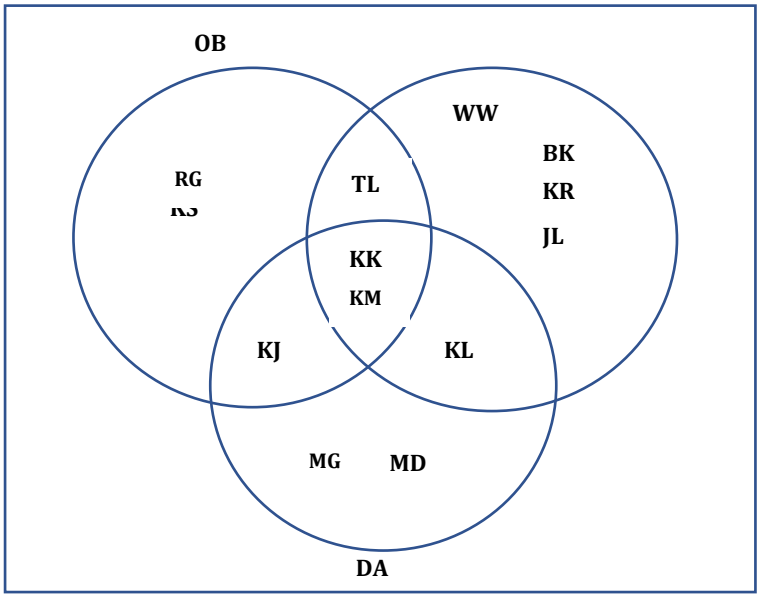

Figure 2. Results of Triangulation Data Analysis (Sugiyono, 2018)

Notes:

OB	:	Observation	KM	:	Comparison Ability
WW	:	Interview	BK	:	Critical Thinking
DA	:	Documentation	MD	:	Independence
KK	:	Classification Ability	KR	:	Creativity
RG	:	Joy	KJ	:	Explaining Ability
KS	:	Social Ability	TL	:	Thorough
KL	:	Collaboration	MG	:	Observant
JS	:	Explanation			

"Classification Ability" (KK) in this finding refers to children who have succeeded in classifying leaves based on their shape. This grouping is done based on the selection concerning the shape and structure of the leaves that children found in their playing environment. Then, they

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provided a significant and pasted it on the book given by the teacher when starting the activity. The leaf classification activity on the leaves found in their living environment also trained them in basic science related to observing and researching various leaf shapes they encountered. Thus, children can classify leaves based on their shape from this activity. They acquired this ability from the search results they performed. The leaf diary activity as the core issue in this study is an activity based on the environment to train children in collecting various types of leaves on plants that children found in their surrounding environment. The findings were then combined according to their shape. After the classification process, the children were asked to paste the leaves on the drawing book provided by the researcher. The description of leaf diary activity applied to early childhood is illustrated in the following figure, which is an example that illustrates leaf classification activities carried out by children who participated in leaf diary activity.

(a)

(b)

Figure 3. (a) A Child Shows the Classification of Leaves Based on Their Shape (b) Children Stick the Classified Leaves on the Drawing Book

On the other hand, **"Comparison Ability"** (KM) refers to children's ability to compare in terms of "longer" and "shorter" exercises on the leaves they have acquired in the activity. The comparison process carried out in the surrounding environment involves sorting the leaves based on length and size. Its implementation involves all children's motor abilities so that this basic ability will be well equipped. In addition, the ability to compare presented in this activity has a role that the basic ability to compare in early childhood is useful for early preparation in studying the concept of numbers towards the next level of material. The comparison activity that they do in leaf diary activity can train their ability to sort objects and good mathematical abilities to be applied in children's mathematics learning. The activities that take place in the leaf diary activity are the same as the herbarium activities, which they paste on the drawing book given by the researcher. After the child determines which leaf is longer or shorter, the child is asked to sort by large and small sizes. In detail, this is seen in the figure 4.

(a)

(b)

Figure 4. (a) A Child Compares Leaves by Size (b) A Child Glues the Leaves According To Their Sizes

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4. Discussion

Based on the data analysis, the leaf diary is one of the activities during the COVID-19 pandemic that teachers or parents can do in introducing the concept of classification and comparing while playing. During the activity, at least there are interesting things that can be described through a snapshot of the activity based on field notes obtained by the researcher:

> *"The children seemed enthusiastic in picking up various types of leaves that were in the yard and the surrounding environment; then, they collected the leaves according to their shape. In addition, they also sort the leaves from the largest to the smallest according to the instructions."*

Children easily classify based on similar leaf shapes and can compare by sorting according to the size of the leaves they have collected during the leaf diary activity. These results show that in practicing classification skills, children in early childhood requires games and concrete objects so that the construct of understanding goes according to the stages of their cognitive development (Delfia & Mayar, 2019; Lisa, 2017; Nurdin & Anhusadar, 2020; Pramana, 2020; Sari et al., 2016). Supporting the above study's findings, the teaching and learning process provided for early childhood should consider each child's developmental stages and characteristics (Misrayeti & Mahyuddin, 2020; Nurhafizah, 2017). This means that learning provided through activities can contain game activities usually carried out by early childhood by elaborating concrete media in the surrounding environment. The leaf diary activity is carried out to support the learning process that cannot be separated from the various learning models in line with the goals and needs of learning (Hewi & Asnawati, 2020; Nurdin & Anhusadar, 2020; Sapriati, 2013). Other studies found that if the use of the surrounding environment as a learning resource is done repeatedly, it is believed that in the future, it will not only be teaching the construct of knowledge gained but also affection for respect for nature with human awareness that they need plants as oxygen producers (Safrizal, 2018; Safrizal et al., 2020). Thus, the physical environment around children can be used as a learning laboratory to practice various basic science and mathematics ability. The results of studies conducted by Lüken & Kampmann (2018), Richland et al. (2006), and Ulni and Suparno (2020) mention that the teaching and learning process with nature is believed to have an effect on children's arithmetic abilities in the early grade levels. In addition, the importance of developing the ability to classify various forms of objects based on their physical forms, such as patterns found on leaves, affects children's spatial ability.

The activity of comparing and classifying leaves through leaf diary activity allows children to develop concrete problem-solving skills that can be seen directly and findings that focus on observation and investigation (Amalina, 2020; Gadzichowski et al., 2018; Sarama & Clements, 2009; Widayati et al., 2020). The forms of skills developed through the activities produced in the leaf diary activity are observing skills, where children are encouraged to pay special attention to the shape and size of the leaves and group them according to their similar shapes. Another thing that children acquire related to learning experiences through leaf diary activity is the skill of comparing, i.e., examining objects in terms of the similarity in size of objects or objects observed in the surrounding environment. Further explanation in the implementation of leaf diary activity is based on the object classification process, which essentially involves the ability to see similarities and differences between objects. This is because the similarity of an object is the main thing that can be seen and explained by a child in the teaching and learning process by using concrete objects. This is an important point in the learning activities developed in the leaf diary activity.

Following Ruth Wilson's opinion, creative play in a natural environment allows children's real intelligence to develop. The essence of learning about the natural environment will not be embedded in the information given to a child because the knowledge presented is not based on information the child has heard, but rather, an understanding of nature and real intelligence will last a long time in children when the interaction between children and the natural world is carried out properly (Fardiah et al., 2019; Suhendro, 2020; Ulfah & Khoerunnisa, 2018). Other studies

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stated that learning through the environment is related to the classification and comparison of what is taught to children in early childhood, in essence, is a process of recognizing values and clarifying concepts in order to develop the attitude skills needed to understand and appreciate the interrelationships between components with one another, so that the gained knowledge or constructs of knowledge exhibit complex hierarchies (Gayford & Saveland, 1978; Wilson, 2018). In line with the above, in a study related to scientific literacy, it was stated that one of the components that manifest the ability to process information from nature, one of which is the environment in the form of plants around students (Safrizal, 2018; Safrizal et al., 2020). This study also focuses on the main thing in inculcating basic science skills so that scientific literacy behaviour is formed, which is a combination of the natural environment with attractive natural learning strategies. Therefore, children's knowledge touches the theory and reaches the realm of application. This explanation fully supports the classification ability formed in the leaf diary activity that a series of activities that ask children to search and collect up to the classification level is the latest way that touches the concept of learning while playing. The classification activities touched the cognitive level and reached the child's psychomotor (Lüken, 2018; Richland et al., 2006; Sarama & Clements, 2009; Ulni & Suparno, 2020). Therefore, planting and fostering basic science skills for similar grouping or classification is easy to obtain and teach to children.

In the concept of introducing mathematics and science to children in early childhood, leaf diary activity essentially introduces children to concrete objects that are often seen and found in their surrounding environment. In addition, the importance of involving children in learning, especially exploring nature as a source and learning media is one of the interesting things so that learning is not only durable, but learning also gives a deep impression in the process of developing cognitive, affective, and psychomotor abilities (Greenes et al., 2004; Jordan et al., 2009). In the discussion above, light activities are contained in this activity. The skills trained in leaf diary activity require some scientific and mathematical abilities in early childhood. This can be seen from every aspect of the trained skills as the analysis results described above. Thus, it is clear that the activities carried out in the leaf diary activity are learning presentations that integrate the introduction of nature with the development of early childhood science and mathematical abilities. It includes leaf classification skills based on their shape and training skills in comparing or measuring the size of leaves obtained from their surrounding environment. In addition to the two abilities above, many early process abilities still need to be trained before children engage with material that leads to numbers. This includes identifying and describing the meaning, match, sorting, comparing, and sorting in order. Several mentioned abilities above are accommodated in one activity wrapped in a leaf diary.

Furthermore, learning mathematics for early childhood essentially begins naturally when involved with the world around them. Therefore, children have a lot of desire and ability to understand and create a child's world order. This is because, for early childhood students, the best way to introduce basic science and mathematics ability is to investigate and manipulate concrete materials and develop problem-solving skills, as shown in the description of the leaf diary activity. The child must classify the leaves according to their physical shape. Furthermore, children also need to learn how to sort the materials from nature before pasting on paper media. Ability training is needed because children need to know what they are selecting and comparing before entering the realm of advanced mathematics and science learning (Hewi & Asnawati, 2020; Marwiyati & Istiningsih, 2020; Ulni & Suparno, 2020). This means that the urgency of developing basic science and mathematics ability in early childhood can be carried out even amid a pandemic, especially through activities based on nature and the surrounding environment. This is because the ability to classify and compare is an ability that can control in solving personal to social problems scientifically. Therefore, the application of abilities that have been formed from leaf diary activity can be actualized in everyday life.

5. Conclusion

The leaf diary activity is one of the learning activities to develop children's ability to compare leaves based on size and classify leaves based on shape. Classifying and comparing activities can help children to be able to develop various thinking skills and build basic concepts in solving problems found in everyday life. Meanwhile, identifying physical shapes and similarities of objects can help children learn about number recognition or math skills on the concepts of big-small and high-low. In addition, children can explore the natural surroundings, so that basic science and mathematics abilities can be fulfilled properly.

Declarations

Author contribution statement

Resti Yulia conceived of the presented idea. Nenny Mahyuddin, Nurhafizah, and Komareeyah Sulong developed the theory of children's science and mathematics, discussed the results, and contributed to the final manuscript.

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Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declaration of interests statement

The authors declare that they have no known competing financial interests or personal relationships that could have influenced the work reported in this paper.

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