

The Influence of Learning Methods and Cognitive Styles on Physical Science Understanding

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Abstract

The purpose of this research is to know the influence of learning method and cognitive style to physical science understanding. This research was conducted in Adhyaksa XXVI kindergarten and TK Pertiwi 1 academic year 2017/2018, using 2 x 2 factorial design experiment method involving 120 samples. The data analysis techniques use two ANAVA and Tukey Test. The results showed that: 1) The understanding of physical science of children taught through discovery learning method is higher than that of children taught by project base learning method $F_{count} = 49,77 > F_{table} = 3,96,2)$ There is interaction effect between method of discovery learning and method of project base learning and cognitive style toward the understanding of physical science, it is based on value $F_{count} = 105,83 > F_{table} = 3,96,3)$ Understanding of physical science child cognitive field independent field given discovery learning method more higher than the children given the method of project base learning $Q_{count} = 17,32 > Q_{table} = 2,95, 4)$ Understanding the physical science of children who have cognitive style field dependent given discovery learning method is lower than in children given the method of project base learning $Q_{count} = -1,24 < Q_{table} = 2,9$.

Keywords: Learning method, discovery learning, project base learning, cognitive style, physical science

1. Introduction

Early childhood science learning is aimed at children having the ability to problems solve, have a scientific attitude, and sharpen sensitivity in exploring to understand the environment. According to the National Research Council Standard (1996: 13), the basic concepts of science should be determined by what children see and do daily, according to the age and development of the child. One concept of science learning for early childhood is physical science. Physical science for early childhood involves direct exploration of an object, material, and event of inanimate objects that exist around the child and integrated in everyday life. Focus their exploration levels from structures made by some materials, moving objects, water, and other liquids, shadows, light, and sound. In early childhood the phenomenon taught is slightly different, packed in an interesting and challenging way to be explored.

Research conducted by Levy (2012), states that children who get experience learning science in kindergarten, then the children understand about the concept and content of science, which will give effect to the achievement of learning outcomes when the next

education. In addition, the results of research conducted by Brostrom (2015), explains that the problems that occur in preschool in science learning, is the ability of a teacher who has not been optimal using a method of scientific teaching so that children can not construct knowledge in understanding the phenomenon of science. Based on the result of the research, the factors that influence the achievement of science learning outcomes when attending primary school are the lack of facilities / tools and materials to study the science, the frequency and duration of teaching of science by the teacher, and the selection of less effective learning method used in science learning

The result of observation and interview result which have been done with some teachers in Kindergarten of Padang Barat subdistrict, the researcher get information that the understanding of physical science of children is still low. At the time of the learning process is seen teachers dominate the class, become the main source of knowledge, less attention to active activities of children, child interaction and less construct knowledge of children. In addition, the science lessons given less interesting to be explored, given classically using conventional methods without much to see the possibility of applying other methods that match the types of materials, materials and tools available.

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The low understanding of physical science in children in addition to influenced by external factors one of the methods of learning, internal factors is an important thing that must be considered by teachers, such as how children receive, process, and compose an information called the cognitive style. In an article written by Sellah, et. all (2017), cognitive style is influenced by the interaction of teachers with students in the learning process, such as approaches, strategies and models used by teachers. This suggests that educators should be able to see how the material is presented in the classroom, because each child when learning has a different cognitive style.

Based on the explanation from the previous research results and supported by the observation result, one of the efforts to solve the problem, it is necessary to conduct a research to study how big the influence of learning method and cognitive style to the physical science understanding. With regard to the required learning methods above, the researchers chose two types of learning methods that are thought to have an effect on understanding the physical science of children in kindergarten, the discovery learning method. and project base learning method. Through this research is expected to bridge the less effective teaching methods used by teachers, and attention to the differences of the cognitive style of each child, thus giving a good influence on the understanding of physical science.

Statement of the problem

Based on the background of the problem, problem identification and problem restrictions that have been described, to further focus this research, then the research problem can be formulated as follows. Are there differences in understanding of physical science between children using discovery learning method with project learning learning method. Is there an interaction effect between the learning method and the cognitive style on the understanding of physical science. Is there a difference understanding of physical science of children who have independent field cognitive style, between using discovery learning method and learning method of project base learning. Is there a difference understanding of physical science of children who have cognitive style field dependent, between using discovery learning method and learning method of project base learning.

Research objective

To know the influence of learning method and cognitive style to physical science understanding

Research hypothesis

H₀₁: Understanding the physical science of children who are taught by using discovery learning method has a higher influence from the learning method of project base learning.

H₀₁: There is an interaction effect between learning discovery learning method and the learning method of project base learning and cognitive style toward physical science understanding

H₀₁: Understanding the physical science of children who have an independent field cognitive style given the method of learning discovery learning is higher in value compared with children who are given the method of learning project base learning.

H₀₁: Understanding the physical science of children who have cognitive style of field dependent given discovery learning method is lower than children who are given the method of learning project base learning.

Literature review

The concept of science learning discussed in this research is the concept of physical science. Dodge et al (2002), defines physical science as the study of the nature of matter and inanimate objects, through the exploration of the material of children learning about weight, shape, size, color, and temperature. This shows that the physical science of science that examines the material objects and inanimate objects. Children learn about things that move and change. National Science Education Standards (NSES) state the results of physical science activities for early childhood, children will build understanding of the nature of objects and materials, such as the position and movement of objects, light, heat, electricity, and magnetism. The focus of physical science for early childhood according to NSES standards is the sfat nature of the material (matter can be solid, liquid, and gas), the movement of the object and energy. Children can understand the concept of physical science through experimenting with objects and observing what will happen after action.

Karen and Sharon (2003), defined physical science for early childhood involving children directly exploring the objects, materials, and events of inanimate objects that surround the child throughout life. The focus of the child explores with physical science encompassing structures made of different types of materials, moving objects, water and other types of liquids, shadows and light, and sound sources (sounds). Kato and Meetreen (2012), defines physical science as a natural science that refers to the nature of an object, such as color and texture. According to the Early Childhood Advisory Council to the Maassachusetts Board of Education (2003), physical science investigates the forces of nature and the basic elements of compounds or natural substances consisting of physics and chemistry. Physics is the study of matter, energy, motion, and style. It deals with speed, leverage, balance, gravity, and mechanical systems. Children can understand these concepts through explorations, such as objects dropped down, tower blocks that, when composed, fall down, corks float in water, and drowned rocks

Based on the above explanation can be synthesized the scope of physical science learning for early childhood is about matter, energy, motion, and style. Understanding of physical science for early childhood in this study refers to the concept of understanding of Bloom Bloom's Taxonomy Revision Lorin W Anderson and David R. Krathwol (2001), which explains that understanding is a person's ability to classify, model, summarize, compare and explain facts or concepts, or principles obtained through communication with others either in writing, verbal, or pictorial. Based on the above, it can be concluded that the understanding of physical science for early childhood is the ability of a child to classify, model, compare, and explain a material phenomenon that includes material, energy, movement, and style.

Learning methods

Implementation of learning requires various components to achieve maximum learning objectives. One of the most important learning components in achieving the learning objectives that have been determined is the use of learning methods. In this research, the chosen learning method is discovery learning method and project base learning method.

Discovery learning method

Discovery learning method is developed based on cognitive view of learning and constructivist principles. According to this principle children are trained and encouraged to learn independently. In other words, constructivist learning emphasizes child-centered learning, whereas the role of teachers is to help children discover facts, concepts, or principles for themselves rather than giving lectures or controlling all activities in the classroom.

According to Jerome Brunner (2006), in conducting activities that are found to find the answer to the problems being faced on their own will make it easier to access the information in memory. Kumari and Rao (2004), explain that discovery is a method that has dimensions where discovery emphasizes learning, experience, and cognitive understanding. This statement explains that in conducting activities that are found to find the answer to the problems being faced on their own will make it easier to access the information in memory. In this case it can be understood that the learning activities in finding answers to the problems being faced done by the discovery of the answer to the problems that are faced by the discovery will be easier in connecting the concept of knowledge previously obtained with the concept of new knowledge.

Discovery learning is a mental process in which students assimilate a concept or a principle. The mental processes such as observing, classifying, making conclusions, and so forth. Moore (2005), reveals the definition of invention learning is a means for students to

engage in problem solving in knowledge or skills development. Discovery learning is deliberate learning through problem solving being supervised following scientific inquiry methods. More more specifically states the discovery learning stages that refer to scientific investigation methods that include: 1) identify problem, 2) develop possible solutions, 3) collect data (4) analyze and interpret data (analysis and interpretation of data), 5) test conclusions (conclusion test).

Based on the above description can be synthesized discovery learning method is a child-centered learning method, where in the learning process of children actively involved through problem-solving activities that aims to find a concept or principle by following the steps of learning invention that includes stimulus, formulation / identification problems, data collection, data processing, verification, and generalization.

Project base learning method

One method of learning that provides opportunities for children to acquire skills and knowledge in depth with the method of project base learning. According to Diffily (2011), educators describe project-based learning methods as a variation of different activities in the days that follow. In other words, everyday activities in different project-based and continuous project-based learning are diverse and sustainable in order to complete the project. In line with the above opinion, Michell (2009) also suggested that the project is defined as an in-depth investigation involving students in design and investigative activities that culminate in the final product or event briefing.

The method of project base learning provides an opportunity for a child to experience a topic in an integrated manner. This is explained by Jones in Helm (2008), ie Project activities give children new skills and opportunities to learn something that interests them. The method of project base learning also provides a learning experience for children about the integrative world and is able to increase their knowledge and thinking. According to Fuller, Dainty & Thorpe (2011), project learning within the organization aims to improve the acceptance of lessons using a series of process-based workshops to produce more meaningful output. This means that project learning is carried out in groups or in an organization to create meaningful products

In doing project-based learning there are eight steps to be taken that provide convenience and guidance for teachers and children to develop project assignments based on content-based learning. The procedures or steps of project-based learning in the classroom according to Richards and Renandya (2002), are as follows: (1) preparation: determine the theme according to the child's interests and determine the final outcome (product), (2) (3) processing: project implementation, (4) presentation: presentation (explaining one by one group results with the teacher and evaluating the final project result) and holding the exhibition in the classroom.

Based on the above explanation can be concluded that the learning method of project base learning is a method of learning that emphasizes the problem solving through collaborative activities or cooperation that aims to create a product or product conducted for several days and continuous and carried out through the steps, 1) preparation, (2) introduction, (3) processing, (4) presentation.

Cognitive style

Each individual has different characteristics, therefore the way a person in the behavior, judging and thinking will be different too. The differences between the person who settled in how to organize and process information and experiences are known as cognitive styles. Cognitive style relates to the way a person faces cognitive tasks, especially in problem solving.

Slavin (2008), defines cognitive style as a form of learning-oriented style to approach learning tasks and process information in certain ways. Based on the definition it is proposed that each person has different cognitive styles in dealing with problem-solving tasks. According to Keefe (1987), cognitive style is part of the learning style that describes behavior habits that remain in a person in receiving, thinking, solving problems and in storing information. It means that the cognitive style is described as the way in which a person processes information or knowledge, the typical way one uses in observing and doing mental activity in the cognitive field. This unique way of individuality that is often unconscious and once formed will tend to persist. Woolfolk (1993) argues that cognitive style is how one receives and organizes information from the world around it. Means the cognitive style is the way individuals process and organize information to respond to environmental stimulation.

Anastasi and Urbina (1988) argue that cognitive style (cognitive style) basically shows a typical and chosen way in understanding, remembering, thinking and solving problems. One dimension of cognitive style that is particularly worth considering in education, is the cognitive style distinguished by the psychological differences namely, the cognitive style of independent field and field dependent. Cognitive style field independent and field dependent need to be considered in the learning given the suitability between the cognitive style of independent field and field dependent. Suitability is the relationship between the cognitive style of independent field in the nature of the relationship between humans and humans, the individual orientation that appears dominantly the orientation that basically appreciate the ability of individuals to achieve achievement. The suitability of the field dependent cognitive style and fellow orientation or the prominence of solidarity (sense of togetherness and cooperation).

Kogan in Slavin (2008), stated there are some other differences in learning styles obtained by educational

psychologists, one of which is related to field dependent versus independence of thinking (field independent). Dependent people tend to see the pattern as a whole and have difficulty separating certain aspects of a situation or a large pattern. People who depend on thinking tend to be more oriented towards others and social relationships. People who have autonomous thought have greater possibilities to perform well in numbers, natural science, and problem-solving tasks.

Methodology

This research was conducted by using experimental method with 2 x 2 factorial design to compare two learning method that is learning discovery learning method and learning method of project base learning and attribute variable that is cognitive style which is classified into two ie cognitive field independent and cognitive style field dependent.

Data collection techniques conducted in this study using two instruments namely data about the understanding of children's physical science using non-test instruments that have been made by researchers, in the form of tests of deeds and interviews in the form of questions on children who viewed from how capable children master the material that has been taught, after testing its validity by expert and cognitive style data in the form of questionnaires that have been made by the researchers after tested by the expert's validity.

The sampling technique was done by multistage random sampling technique, with the following steps: (1) calculating the number of sub-districts in the Padang city, (2) doing random of 11 sub-districts in the town of Padang, conducted a random to select one of five clusters in Padang Barat sub-district, selected by group 2. There were 25 groups B Kindergarten, (4) conducted a random to select 2 kindergartens from group 2 to be used as research samples.

Data analysis techniques in this study were tested with two way variance analysis (ANAVA) 2 x 2. In order to test the hypothesis can be done it is necessary to test the requirements analysis of the normality test and homogeneity test. the normality test was performed by Lifefors Test and homogeneity test was performed by Barlett Test. Subsequent tests were performed using the Tukey Test.

Result and Discussions

After analyzing the data by using variance analysis (ANAVA) and with Tukey test, the discussion of research result will be centered on four hypotheses that have been tested as follows:

Understanding of physical science in groups of children who are given discovery learning method is higher than the group of children given the method of learning project base learning.

Based on the calculation of ANAVA that $F_{\text{count}} = 49,77 > F_{\text{table}} = 3,96$ at significant level $\alpha = 0,05$ thus H_0 is rejected and alternative hypothesis H_1 accepted, it means alternative hypothesis that there is difference of physical science understanding between two groups of children given the two discovery learning method study and project base learning as a whole proved significant. The difference of the average score of knowledge understanding of physical science of children given learning discovery learning method $\bar{X} = 49.67$ is significantly higher than the group of children given the method of learning project base learning $\bar{X} = 46.27$. The results show that overall understanding of physical science in groups of children given discovery learning method is higher than the group of children given the method of learning project base learning.

Based on these differences it can be explained that discovery learning methodology is developed based on cognitive view of learning and constructivist principles. Results of research conducted by Kistian et. al, (2017), explains that learning discovery learning method focuses on the child in the learning process, with this method the teacher acts only as mentor and facilitator in directing and developing the knowledge of the child by providing problems to be solved through scientific steps, which begins with stimulation, problems, collecting data, verifying data, and generalizing. Through discovery learning methods children participate actively by finding their own, self-investigate by following the steps of scientific inquiry so that the results obtained will be durable in the child's memory.

According to Bruner (2006), in conducting activities that find the answer to the problems being faced on their own, it will be easier in accessing information in memory. In this case it can be understood that the learning activities in finding answers to the problems that are faced by the discovery will be easier in connecting the concept of knowledge that has been obtained with the concept of new knowledge.

The learning method of project base learning involves the active participation of children and teachers. Vartainen (2008) defines project-based learning (PJBL), a project program focused on project outcomes and learning motivation from the environment in groups. Project-based learning prioritises cooperation between individuals to complete the project. Play activities conducted with groups provide opportunities for children to acquire social skills. The learning method of project base learning in its implementation often spends a lot of time and makes it difficult to find creative ideas to design an activity and sometimes it is difficult to motivate children to learn.

Based on the above description can be stated that the group of children taught by discovery learning method is more effective than the group of children taught by the method of learning project base learning. It can be recommended that discovery learning method of learning more suitable applied in improving the understanding of physical science.

There is an interaction between the learning method and the cognitive style of physical science understanding

The result of ANAVA AxB calculation shows that $F_{\text{count}} = 105,83 > F_{\text{table}} = 3,96$ at significant level $\alpha = 0,05$ thus H_0 is rejected and H_1 accepted. Thus it can be decided that there is a significant interaction effect between the learning method, and the cognitive style of physical science understanding. This interaction signaling will affect the form of interaction that occurs, meaning the interaction effect will have significance if the tested each level of treatment.

Moeslihatoen (2004), learning method is basically a means used by teachers in the learning process, to achieve learning objectives that have been planned previously. The success of the use of learning methods is also determined by how the child can accept the process of pursuit in accordance with the cognitive style it has. According to Keefe (1987), cognitive style is part of the learning style that describes the behavior that remains in a person in receiving, thinking, solving problems, and in storing information.

With the characteristics and different cognitive styles of children, the selection of appropriate learning methods in accordance with the characteristics and cognitive style of children is one of the important parts that support success in learning. from the findings obtained in this study, it can be concluded that there is interaction between learning methods and cognitive style to the understanding of physical science

Physical science understanding between groups of children who have independent field cognitive style and given the treatment of discovery learning method is higher than the group of children given the method of learning project base learning.

Based on the calculation of the analysis of advanced variance with Tukey test to compare the understanding of physical science group that has cognitive style field independent given discovery learning method and learning method of project base learning obtained value $Q_{\text{count}} = 17,32 > Q_{\text{table}} = 2,95$ at significant level $\alpha = 0.05$ thus H_0 is rejected and H_1 accepted. In addition, the average score of children who have an independent field cognitive style given discovery learning method $\bar{X} = 56.25$ higher than that given the method of learning project base learning $\bar{X} = 44.3$.

The third hypothesis test result proves that H_1 accepted that the group of children who have cognitive style field independent given discovery learning method is higher than the group of children who are given the method of learning project base learning. It is said that these two forms of learning method have the same goal in improving the understanding of physical science, but have differences in their implementation. Balim (2009), implementation of discovery learning method prioritizes the activeness of children in finding knowledge about a concept that must be achieved by following the steps of scientific inquiry.

Discovery learning method involves active learners to improve reasoning, ability to think freely, and train children cognitive skills by finding and solving problems encountered using prior knowledge, thereby generating new knowledge that is really meaningful to him. Winkle (1996), children who have an independent field cognitive style are grouped as people who have analytical skills, able to describe as detailed as possible a context, have the ability to remember, have a high conscientious self motivation, and able to solve problems. From the description above can be recommended that discovery learning method more effectively used for children who have an independent field cognitive style to improve the understanding of physical science.

Physical science understanding between groups of children who have a cognitive style of field dependent is lower given discovery learning method compared to the learning method of project base learning.

Based on the calculation of the analysis of advanced variance with Tukey test to compare the physical science understanding of the group of children who have cognitive style of field dependent given the learning method of discovery learning and group of children given the learning method of project base learning obtained $Q_{\text{count}} = -1.24 < Q_{\text{table}} = 2.95$ or $Q_{\text{count}} < Q_{\text{table}}$ at significant level $\alpha = 0.05$, thus H_0 is rejected and H_1 is accepted. The average score of group of children who have cognitive style of field dependent is given discovery learning method $\bar{X} = 47,5$ lower than using learning method of project base learning $\bar{X} = 48,25$. The result of the fourth hypothesis test is accepted to prove that the group of children who have cognitive style of field dependent given the learning discovery learning method is lower than the group given the method of learning project base learning.

The cognitive style is basically owned by each child in itself with different trends in dealing with problem-solving tasks. Witkin (2006), cognitive field dependent style has characteristics such as: low analytical skills, tend to think globally, oriented social, have the ability to remember or low accuracy, have extrinsic motivation, and less able to solve the problem specific. This kind of characteristic when given discovery learning learning method that is more priority in finding a concept or breaking a given problem, less effective to apply. Children who have a field dependent cognitive style prefer to learn in a group way.

Therefore the learning method of project base learning is recommended for children who have cognitive style of field dependent to improve physical science understanding. This statement is supported by the results of research undertaken by Vartiainen (2008), project-based learning prioritizes cooperation between individuals to complete the project. From the explanation that has been figured can be said that physical science understanding for children who have cognitive style field dependent can be improved by using the method of project base learning.

Conclusion

Based on the results of the presentation on the results and discussion, it can be put forward some conclusions as follows:

In general, the understanding of physical science of children who are taught by using discovery learning method has a higher influence of the learning method of project base learning.

There is an interaction effect between learning discovery learning method and learning method of project base learning and cognitive style toward physical science understanding

Understanding the physical science of children who have an independent field cognitive style given the method of learning discovery learning is higher in value compared with children who are given the method of learning project base learning.

Understanding the physical science of children who have cognitive style of field dependent given discovery learning method is lower than children who are given the method of learning project base learning.

References

- [1]. H Witkin, (2006), Field Dependent and Field Independent Cognitive Styles and Their Educational Implication, pp. 8-9
- [2]. Ali Gunay Balim, (2009), The Effect of Discovery Learning on Students Succes and Inquiry Learning Skills, pp.3
- [3]. Agus kistian, (2017), The Effect of Discovery Learning Method on The Math of The V SDN 18 of Banda Aceh, Indonesia, British Journal of Education, Vol. 5, No. 11, pp.1
- [4]. Anita, E. Woolfolk, (1993), *Educational Psycolgy*, Terjemahan, pp.96
- [5]. Anne Anastasi dan Susana Urbina, *Psychological Testing*, (1998), pp.446
- [6]. B Veena Kumari and Digumantri Bhaskara Rao, (2004), *Methods of Teaching Social Students*, pp. 105
- [7]. Diane Trister Dodge, et all, (2002), *The Creative Curriculum For Preschool, Fourth Edition*, pp. 142
- [8]. Deborah Diffily, Project-Base Learning, Meeting Social Studies Standards and The Needs of Giffted. *Gifted Child Today*, Summer; 25, 3; Proquest, h. 41.
- [9]. Early Childhood Advisory Council to the Massadussets Board Education (2003),, Guidelines for Preschool Learning Expeiences, pp. 19
- [10]. James W. Keefe, (1987), *Learning Style Theory and Practice*, pp.7
- [11]. Jarome S. Brunner, (2006), E-Book: In search of Pedagogy Volume I The Selected works of Jarome S, pp. 65
- [12]. Judith Harris Helm, (2008), *Got Standards? Don't Give Up On Engaged Learning, (Beyond the Journal: Young Children on the Web*, pp.2
- [13]. Kenneth D. Moore, (2005), *Effective Instructional Strategies From Theory to Practice*, pp. 295
- [14]. Lusweti Sellah, et.al, (2017), "Analysis of Student Teacher Cognitive Styles Interaction: An Approach to Understanding Learner Performance", *Journal of Education and Practice*, Vol. 8, No.14, pp. 9

- [15]. Lorin W Anderson dan David R. Krathwol, *A Taxonomy for Learning* (2001), *Teaching, and Assesing*, pp. 67
- [16]. Michell Sascha, et all, (2009), The Negotiated Project Approach: Project –Base Learning without Leaving the Standards Behind, *Early Childhood Education Journal*, pp. 339.
- [17]. Mesut Sac,kes *et.al*, (2010), The Influence of Early Science Experience in Kindergarten on Children’s Immediate and Later Science Achievement: Evidence From the Early Childhood Longitudinal Study, *Journal Of Research In Science Teaching*, Vol. 48 No. 2, pp. 13
- [18]. Moeslihatoen, R, (2004). Metode Pengajaran di Taman Kanak-Kanak, pp.7
- [19]. National Committee on Science Education Standards and Assesment National Research Council, (1996), *National Science Education Standard*, pp. 13
- [20]. Robert E. Slavin, (2008), *Pskilogi Pendidikan Teori dan Praktik*, pp. 168
- [21]. Stig Brostrom, (2015), Science in Early Childhood Education, *Journal of Education and Human Development*, Vol. 4, No. 2(1), pp. 107-124
- [22]. Tero Vartainen, (2008), Moral Conflicts in Project –Base Learning in ISD, *Technology & People*, Vol.23 ISS 3, pp. 265-28
- [23]. Tsuguhiko Kato and Bat Dykstra Van Meetreen, (2012), Physical Science in Constructivist Early Childhood Classroom, *Childhood Education*, pp. 2
- [24]. W.S. Winkel, (1996), *Psikologi Pengajaran*, pp.53