

The Influences of Cognitive Styles and Learning Strategies on the Students' Learning Achievement in Natural Sciences Subject

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ABSTRACT— *It is believed that every normal human has a cognitive style in learning something and the cognitive style influences learning achievement. However, not only the cognitive style but also some factors can also influence learning achievement. One of the important factors is learning strategy. Two different learning strategies, discovery and expository, are believed can result different levels of learning achievement especially in cognitive domain. Meanwhile, IPA (natural sciences) subject in primary schools should be learned by critical ways of thinking because of its characteristics that has two sides namely process (the investigation) and product (the knowledge). It is interesting to investigate the influences of the different learning strategies on students' learning achievement in IPA subject. Moreover, we can deepen our understanding by investigating the influences of both the cognitive styles and the learning strategies on students' learning achievement in IPA subject. The research in SDN Kalisari 02 Pagi in Kecamatan Pasar Rebo Jakarta Timur (Pasar Rebo district in East Jakarta) shows that in IPA subject, cognitive style and learning strategy have significant influences to the students' learning achievement. For the students who have dependent cognitive style, expository learning is more effective and will bring high learning achievement. Meanwhile, for the students with independent cognitive style, discovery learning is more effective and will result high learning achievement.*

Keywords— learning strategies, discovery, expository, cognitive style, independent cognitive style, dependent cognitive style, learning achievement

1. INTRODUCTION

Talking about the quality of education (represented by) students' achievement, it cannot be separated from influencing factors, that is the fact that the achievement is a result of some interactions factors, either those that come from students (ability, interest, talent, intrinsic motivation, and cognitive style) that is called internal factors or those that come from environment (such as teacher, learning material, learning strategy used by a teacher, evaluation system, physical means, family and society) that is called external factors including culture value system that influencing school, home and environment.

This research is limited to one of external factors as an independent variable, that is learning strategy (as the first independent variable), and students' cognitive style (as moderator/attribute variable). It is predicted that both factors influenced students' achievement. The achievement that will be investigated is students' achievement in IPA subject (natural sciences subject taught in level VI primary school).

Some research results have been the backgrounds of this research, such as: firstly, a research from Moegiadi shows that primary school students in Indonesia have low ability to learn IPA and mathematics (Moegiadi, 1987 p.10). Secondly, from some observations and interviews to some IPA teachers in some primary schools located in East Jakarta, such as SDN Kalisari 02 Pagi, it can be concluded that the teachers complained that IPA curricula in primary schools are over loaded, therefore the teachers have to race with time to achieve the target of the curricula. This condition has forced the teachers to use 'lecture' and 'ask and answer' teaching methods rather than student active learning, hence the achievements of the students were in low level cognitive domain.

Actually, discovery learning is better to use than the two strategies mentioned before. The discovery learning has intention to combine existing knowledge of students with a new knowledge to find concepts, principles, and rules of IPA (natural sciences). Therefore, in discovery learning, existing knowledge of students are significantly considered.

On the basis of the facts and the research results, this research investigated 'the influence of learning strategy and students' cognitive style (field independent and field dependent) on primary school students' achievement in IPA subject'. In this research, learning strategy is defined as independent variable and students' cognitive style as attribute variable. Students' achievement in IPA subject is defined as dependent variable. In independent variable that is learning strategy, this research is limited to the treatment of discovery learning strategy (experiment), and expository learning strategy as a control. In other words, the experiment group of students used discovery and the control group students used expository.

Attribute variable that is students' cognitive style is limited to field independent and dependent cognitive style. Cognitive style is a part of learning style related to relatively stated habitual acts in someone mind in receiving, processing, and keeping information.

Finally, dependent variable that is students' achievement is limited to the learning achievement related to learning materials taught by the teachers to primary school students level VI, semester 1, in the topics of (1) the characteristics of living things and (2) the breeding of living things.

2. STUDENTS LEARNING ACHIEVEMENT IN IPA (NATURAL SCIENCES)

Definition of learning posed by Kingsley and Briggs in Snelbecker, that is a process of changes behavior as a result of training or practice followed by an individual where he/she belongs. The changes can be comprehension, behavior, perception, motivation, or combination of them. Meanwhile, Winkel said that learning is physical or mental activities happened in active interaction with environment that results changes in knowledge, comprehension, value and attitude. These changes are relatively constant and remain in his/her mind (Winkel, 1996 p.52). This is to say that someone who have learned can be seen from changes or the achievement of new ability. After learning someone is able to do something that cannot be done before learning.

Not all changes happened in a person can be considered as a learning achievement. Changes caused by growth and maturity are not the effect of learning, because they are more instinctive. This satisfied what Gagne said that learning is a change in ability of human which is not caused by a growth process (Gagne, 1977 p.3) The same with changes caused by disease or exhausted, cannot be classified as learning achievement because they happened over human's ability. In this case Burke said that learning is a changed behavior that happened permanently which is not caused by temporary condition of body like diseases or drugs (Burke, 2000 p.1). Meanwhile, Barbara argues that learning concerns with changes that relatively permanent in someone's knowledge and behavior caused by experiences (Seels and Richey, 1994 p.2). Based on all definition about learning, it can be concluded that learning is an ability achieved by someone as a result of interactions with environment, not because of physical growth or ability or drugs. Changes as an effect of a learning process happened step by step and not temporarily.

Ability achieved by someone after doing a learning activity is called learning achievement. It satisfies what Sudjana said that learning achievement is abilities owned by a person after having his/her learning experience (Sudjana, 1990, p.22) Bloom classified three aspects of learning results these are cognitive, affective and psychomotor. Cognitive aspect is an aspect of learning that has to do with intellectual learning achievement includes (1) knowledge (2) comprehension (3) application (4) analysis (5) synthesis, and (6) Evaluation. (Kratwohl, Bloom, and Masia, 1973 p. 7) (Bloom, 1981, p.7). Affective aspect has to do with attitude, meanwhile psychomotor aspect with movement (Harrow, 1976, p.1-2).

On the other side, Gagne classified learning achievement to be five categories, these are: (1) intellectual capability (2) cognitive strategy (3) information (4) attitude, and (5) motor ability (Gagne, Briggs, and Wager, 1992 p.43-51). Intellectual capability is a skill that can make someone able to interact with environment by using symbols. These learning achievement include the ability of (a) discrimination (b) concrete concept (c) defined concept (d) rules, and (e) higher-order rules-problem solving) Cognitive strategy concerned with students' strategy to show attention, memory, and their thinking (Gagne, Briggs, Wager, 1992 p.66). Information or verbal knowledge concerned with the ability to have a label or name, fact, and other scientific fields that are tidily arranged in students' mind (Gagne, Briggs, Wager, 1992 p.85). Attitude is a tendency that influences which alternative action will be taken (Gagne, Briggs, Wager, 1992 p.86). Motor skills are the movement of muscles as the basis of smooth physical action (Gagne, Briggs, Wager, 1992 p.95).

Basically, the aspects of learning from Gagne are not different with those from Bloom. Intellectual capability, cognitive strategy, and information from Gagne can be considered as the same with Cognitive aspect from Bloom, attitude from Gagne is the same with affective aspect from Bloom, and motor skills from Gagne is the same with psychomotor aspect from Bloom. They differ only in stressing. Bloom stresses to the results of learning, meanwhile Gagne to the process of learning (Winkel, 1996 p.240).

Learning achievement relates to learning goals. Winkel said that basically learning goals are the learning achievement to be achieved by students after the process of learning. Furthermore, Sudjana said that Indonesian educational system uses Bloom's taxonomy of learning for the formula of education and instruction goals. Hence, cognitive, affective and psychomotor are the learning aspects that have to be achieved by Indonesian students.

Carin and Sund explained that natural sciences are the way to explore universe through collected data collected from observations and controlled researches. Hungerford, Volk and Ramsey divided natural sciences to be two sides namely process (the investigation) and product (the knowledge). In the process side we collect facts and try to understand how to relate facts to interpret them. Meanwhile, in the product side the results are principles, theories, concepts, or facts dedicated to explain nature phenomena. In Indonesian Basic Education Curricula it is explained that natural sciences relate to the way we systematically uncover the nature, therefore natural sciences are the process of discovery. It is hoped that science education can facilitate students to learn themselves and the nature surround them, and finally to apply the knowledge in their lives. Considering the curricula, therefore the achievement in natural sciences education in this research is cognitive aspects in understanding science phenomena including remembering (C1), understanding (C2), and applying (C3).

3. COGNITIVE STYLES AND LEARNING STRATEGIES IN NATURAL SCIENCES SUBJECT

3.1 Discovery Learning Strategy

One of cognitive instructional strategies suggested by Jerome Brunner is discovery learning. He said that discovery learning is suitable for 'exploring knowledge' by humans. This learning strategy will bring the best result for solving humans' problems and uncovering knowledge about them. Discovery learning can make students feel confident to pose ideas about the learning materials. In discovery learning the students try to figure out those that have been stated as instructional goals. Meanwhile, Carin AA. and Sun explained discovery learning as the mental process of assimilating concepts and principles, learning how to use the mind to discover. In this case, Amin said that discovery is an activity or subject which is designed to make students able to figure out concepts and principles through their mental process.

3.2 Expository Learning Strategy

In learning context, expository learning is a strategy used by teachers to explain facts, ideas, and other important information to their students. This strategy tends to make the teachers 'text book' oriented. In this strategy, initially the teachers give explanations, definitions, principles, and concepts to the students in the form of verbal, 'ask and answer', and tasks. The students follow the teachers' instructions carefully. With this strategy, the students are not necessary to find definitions, principles, and concepts because they have been provided by the teachers. In terms of the 'use of time', this strategy is more efficient than the former strategy, but it has less impact in students mind because they don't critically think about the learning materials.

3.3 Cognitive Style

Specific style used by someone in learning can be defined as cognitive style (Winkle). Charles said that cognitive style is a construct of different ways from someone in facing and selecting learning situation strategy. Cognitive style is a learning style owned by the students confidently so they feel joy in learning (Djahiri). Nasution classifies cognitive styles to be four styles namely field dependent, field independent, impulsive-reflective, and receptive-intuitive. In this research only field dependent and field independent will be investigated. Based on longitudinal study done by H Witkin, the characteristics of field dependent students are: 1) influenced much by environment, in this case is childhood education 2) educated to always pay attention to other people 3) always remember to something in social aspects 4) talk slowly to make people understand to what they say 5) have a wide social relationships 6) need more guidance to understand something 7) more sensitive to criticism and tend to avoid personal criticism. Meanwhile Nasution posed some characteristics of field independent students as follows: 1) do not pay attention to other people norms 2) speak quickly without considering whether people understand or not 3) do not put social relation as something important 4) do not need detail guidance 5) able to accept criticism for improvement.

Based on the characteristics of discovery and expository learning strategies as well as the characteristics of field dependent and independent students, it can be predicted that in IPA (natural sciences) teaching-learning process, field independent students who are using discovery learning strategy will have higher achievement compares to the same cognitive style students who are using expository learning strategy. In contrary, field dependent students who are using expository learning strategy will have higher achievement compares to the same cognitive style students who are using discovery learning strategy.

4. THE INFLUENCES OF COGNITIVE STYLES AND LEARNING STRATEGIES ON THE STUDENTS' LEARNING ACHIEVEMENT IN NATURAL SCIENCES SUBJECT

4.1 Research Design

This research employed experiment with 2 x2 factorial groups. Dependent variable in this research is students' achievement in natural sciences subject. Meanwhile, stated as independent variable is learning strategy and as attribute variable is cognitive style. The research design can be seen in a table as follow:

LEARNING STRATEGY (A)	DISCOVERY (A1)	EXPOSITORY (A2)
	COGNITIVE STYLE (B)	
FIELD INDEPENDENT (B1)	A1 B1	A2 B1
FIELD DEPENDENT (B2)	A1 B2	A2 B2

Figure 1 :

- A1 : group of students with discovery learning strategy
- A2 : group of students with expository learning strategy
- B1 : group of students with field independent cognitive style
- B2 : group of students with field dependent cognitive style
- A1 B1 : group of field independent students with discovery learning strategy
- A2 B1 : group of field independent students with expository learning strategy
- A1 B2 : group of field dependent students with discovery learning strategy
- A2 B2 : group of field dependent students with expository learning strategy

4.2 Population and Sample

Population for this research is all (59) government primary school students in Kecamatan Pasar Rebo Jakarta Timur (Pasar Rebo district in East Jakarta). From the population, SDN Kalisari 02 Pagi was taken as possible population for the reason that the population has homogeny school circumstances, media, available tools, knowledge and teachers' ability as well as students' background. Taken as 'purposive random sampling' was 80 students from SDN Kalisari 02 Pagi.

4.3 Hypothesis

- 1). a). There is no a significant difference in learning achievement between students who used discovery and expository learning strategy.
 $H_0 : \mu A_1 = \mu A_2$
- b). There is a significant difference in learning achievement between students who used discovery and expository learning strategy.
 $H_1 : \mu A_1 > \mu A_2$
- 2). a). There is no a significant difference in learning achievement between students who have field independent and dependent cognitive style.
 $H_0 : \mu B_1 = \mu B_2$
- b). There is a significant difference in learning achievement between students who have field independent and dependent cognitive style.
 $H_1 : \mu B_1 = \mu B_2$
- 3). a). There is no a significant difference in learning achievement between students with field independent cognitive style who used discovery and expository learning strategy

- $H_0 : \mu A_1B_1 = \mu A_2B_1$
- b). There is a significant difference in learning achievement between students with field independent cognitive style who used discovery and expository learning strategy
- $H_1 : \mu A_1B_1 > \mu A_2B_1$
- 4). a). There is no a significant difference in learning achievement between students with field independent cognitive style who used discovery and expository learning strategy
- $H_0 : \mu A_1B_2 = \mu A_2B_2$
- b). There is a significant difference in learning achievement between students with field independent cognitive style who used discovery and expository learning strategy
- $H_1 : \mu A_2B_2 > \mu A_1B_2$
- 5). a). There is no a significant difference in learning achievement between students with field independent and field dependent cognitive style who used discovery learning strategy
- $H_0 : \mu A_1B_1 = \mu A_1B_2$
- b). There is a significant difference in learning achievement between students with field independent and field dependent cognitive style who used discovery learning strategy
- $H_1 : \mu A_1B_1 > \mu A_1B_2$
- 6). a). There is no a significant difference in learning achievement between students with field independent and field dependent cognitive style who used expository learning strategy
- $H_0 : \mu A_2B_2 = \mu A_2B_1$
- b). There is a significant difference in learning achievement between students with field independent and field dependent cognitive style who used expository learning strategy
- $H_1 : \mu A_2B_2 > \mu A_2B_1$

4.4 Research Result

In IPA subject, some research results dealing with students' learning achievement were found as follows:

1. The learning achievement of the students who used discovery learning strategy is significantly higher than those who used expository learning strategy ($H_1 : \mu A_1 > \mu A_2$). Theoretically, it can be considered that the students who use discovery learning have hands on experiences in finding some concepts, therefore they have more meaningful learning rather than just accepting the concepts like the students who used expository learning.
2. The learning achievement of the students who have field independent cognitive style is significantly higher than those who have field dependent cognitive style ($H_1 : \mu B_1 = \mu B_2$). It can be considered that the students with field independent cognitive style have higher motivation rather than the students with field dependent cognitive style, especially when they have tests, criticism, and less learning guidance.
3. The learning achievement of the students with field independent cognitive style who used discovery learning strategy is significantly higher than those who used expository learning strategy ($H_1 : \mu A_1B_1 > \mu A_2B_1$). It can be considered that in discovery learning strategy, high motivation is needed to discover some concepts and it is more suitable for the students who have independent cognitive style.
4. The learning achievement of the students with field dependent cognitive style who used expository learning strategy is significantly higher than those who used discovery learning strategy ($H_1 : \mu A_2B_2 > \mu A_1B_2$). It can be considered that in expository learning strategy, learning goals and materials have been set up completely and systematically and do not need more exploration, hence this strategy is more suitable for the students with field dependent cognitive style.
5. In using discovery learning, the learning achievement of the students with field independent cognitive style is significantly higher than those of the students with field dependent cognitive style ($H_1 : \mu A_1B_1 > \mu A_1B_2$).

6. Contrary, in using expository learning, the learning achievement of the students with field dependent cognitive style is significantly higher than those of the students with field independent cognitive style ($H_1 : \mu A_2B_2 > \mu A_2B_1$).

5. CONCLUSION

Teaching IPA subject (natural sciences) in primary school is not the same with teaching social sciences because natural sciences have two sides of knowledge namely process (the investigation) and product (the knowledge). In the process side we collect facts and try to understand how to relate facts to interpret them. Meanwhile, in the product side the results are principles, theories, concepts, or facts dedicated to explain nature phenomena. Therefore, natural sciences are the process of discovery. Hence, teaching sciences needs an appropriate learning strategy. This research is to investigate the influences of discovery and expository learning strategy on students' achievement in IPA subject. On the other side, some other factors also responsible for the success of studying natural sciences, namely cognitive styles. Therefore, this research also aims to uncover the influences of cognitive styles together with the learning strategies on the students' achievement.

After conducted experiment with 2 x2 factorial groups to 80 students from SDN Kalisari 02 Pagi, then some data can be collected and interpreted as follows:

1. On the basis of the findings, it can be concluded that in IPA subject, cognitive style and learning strategy have significant influences to the students' learning achievement.
2. For the students who have dependent cognitive style, expository learning is more effective and will bring high learning achievement.
3. For the students with independent cognitive style, discovery learning is more effective and will result high learning achievement.

It is hoped that these research findings will give broader comprehension to natural sciences teachers in Indonesian Primary School especially in improving students' achievement.

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