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The Effect of Cognitive Style and Learning Independence on High School Student Learning Outcomes on Biodiversity Materials

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Abstract
To get maximum learning outcomes, students are not only required to have independence, but also need to be supported by students' cognitive styles. This study aims to analyze the effect of cognitive style on student learning outcomes, analyze the effect of learning independence on student learning outcomes, and the interaction between cognitive style and learning independence on student learning outcomes. The research method used was ex post facto with a 2x2 factorial research design. Data were analyzed using two-way Anava and the Tukey test. The results of the study concluded that there is an influence of cognitive style on learning outcomes, there is an influence of learning independence on learning outcomes, and there is an interaction between cognitive style and learning independence on student learning outcomes.

Keyword : Cognitive Style, Learning Independence, Learning Outcomes

INTRUDUCTION

At present the learning process in schools is oriented towards the 2013 curriculum which emphasizes character and competency based education. The model used to create a learning situation in Biology learning is part of Science education and as one of the subjects in schools that is expected to achieve the existing national education goals. Anggraeni (2013), Biology learning is related to how to find out and understand nature and living things in a systematic way so that Biology learning is not only the mastery of a collection of facts but also the process of discovery.

To create a conducive and pleasant learning atmosphere the teacher must know the characteristics of students' cognitive styles. Gunawan (2004) states that students who learn by using their dominant cognitive style will achieve a much higher value than if they learn in ways that are not in line with their cognitive style. Cognitive style that can be applied in biology learning to improve learning outcomes is the Field Dependent-Field Independent cognitive style.

According to Altun, A. & Cakan, M (2006) that students who have a Field Independent cognitive style are characterized by understanding objects that are separate from the environment, separating relevant parts, creating existing information structures, reorganizing information and tending to be more

efficient in remembering parts - old information section. While students who have a Field Dependent cognitive style according to Wooldridge (2006) describe students who have a Field Dependent cognitive style depending on the structure of the environment, the learning process depends on experience, has short attention that is easily changed, likes to study the environment, chooses learning situations according to feelings and experiences, socially oriented and less oriented towards achievement and competition.

Another factor that influences learning outcomes in biology learning is learning independence. According to Umar & La Sulo (2007) "Learning independence is defined as a learning activity that takes place more driven by their own volition, self-choice, and accompanied by a sense of responsibility from the learner". According to Fitriana (2015) Students who have high learning independence will try to complete the tasks given by the teacher, conversely students who have low learning independence will depend on others. Students have been able to learn independently if they have been able to do the learning task without being dependent on others. Basically, independence is the behavior of individuals who are able to take the initiative, able to overcome problems, have confidence, are responsible and can do something themselves without depending on others (Yamin, 2007).

The results of research conducted by Suryanti (2014), show that there is a relationship between cognitive learning styles and student learning outcomes Research conducted by Chermahini, et al. (2013) concluded that there is an influence between learning styles on learning outcomes. Research conducted by Rijal (2015), the results show that there is a positive relationship between student learning independence with cognitive learning outcomes in biology and cognitive style of students with cognitive learning outcomes in biology students.

COGNITIVE STYLE

Cognitive style is a bridge between cognition and actions that show one's personality (Sternberg & Grigorenko, 2001). According to Bassey (2009) revealed that cognitive style is a process or style of control that arises in students who can situationally determine students' conscious activities in organizing, organizing, receiving, and spreading information and also determine student behavior. Cognitive style can be said as a way for students to capture information, process information and execute information in an action or behavior when the learning process is carried out by these students consistently.

Cognitive style can be distinguished based on several ways of grouping, one of which is done by Witkin (1977) who identifies and groups a person based on the characteristics of the global analytic continuum. Based on this grouping method, Witkin divides cognitive styles into 2 groups, namely dependent and field independent cognitive styles. A person with a field dependent cognitive style is a person who thinks globally, accepts existing structures or information, has a social orientation, chooses a profession that is social skills, tends to follow existing goals and information, and tends to prioritize external motivation, whereas people who have independent field cognitive style is someone with characteristics capable of analyzing objects separate from their environment, able to organize objects, have an impersonal orientation, choose professions that are individualized, and prioritize motivation from within oneself.

INDEPENDENCE OF LEARNING

Independence does not only apply to children but also at all age levels. Every human being needs to develop independence and carry out responsibilities in accordance with their capacity and stages of development. Naturally children have the drive to be independent and responsible for themselves. Darmayanti (2004) states that learning independence as a form of learning that has the responsibility to plan, carry out and evaluate its business, while Umar & La Sulo (2005) say that independence in learning is a learning activity that takes place more driven by self-will, self-choice and own responsibility of learning.

Student learning independence is needed so that students have the responsibility in organizing and disciplining themselves. In addition, in developing learning abilities and self-will, these attitudes need to be possessed by students as learners because they are characteristic of the maturity of educated people. So it can be concluded that learning independence is one's ability to carry out learning activities with full confidence and responsibility for his actions (Miftaqul, 2016).

The independence of students in learning is a very important thing and needs to be developed in students as students. Yamin (2008) revealed the importance of independence, that learning independence implemented by students brings positive changes to intellect.. Learning independence has characteristics that occur in each student that can be observed with changes in attitudes that emerge through behavior patterns.

LEARNING OUTCOME

According to Sudjana (2010) learning outcomes are abilities obtained by students after receiving their learning experience. Learning outcomes in a broader sense include the cognitive, affective, and psychomotor domains. Winkel explained that learning outcomes are a change that results in people changing their attitudes and behavior (Purwanto, 2011). Learning outcomes are various patterns of actions, values, understanding, attitudes, appreciation, and skills (Suprijono, 2016). According to Anderson & Krathwohl (2010) learning outcomes are measurable student abilities after going through the learning process. These abilities include the cognitive, affective, and psychomotor domains that indicate a change for the better.

Anderson (2010) cognitive learning outcomes based on Bloom's revised taxonomy by Anderson and Krathwohl can be explained as follows:

a. Remember, namely the ability to recite what has been learned. This level includes two kinds of cognitive processes, namely recognizing and recalling.
b. Understand, which is the ability to connect initial knowledge and new knowledge. The level of understanding includes interpreting, giving examples (exemplifying), classifying, summarizing, attracting inference (inferring), comparing and explaining .
c. Apply, which is the ability to solve problems using certain procedures. This level includes executing and implementing.
d. Analyze, namely the ability to describe problems and determine the relationship between them. Analyzing includes the ability to distinguish (differentiating), organizing, and finding implied meaning (attributting).
e. Evaluate, i.e. consider problems, based on certain criteria. Evaluating has two categories, checking and critiquing.
f. Create, which is a process of combining various parts into a single unified whole. Creating includes making, planning, and producing.

From some of the above opinions it can be concluded that learning outcomes are results obtained by students after the students carry out learning and learning activities as well as evidence of success that has been achieved by someone involving cognitive, affective and psychomotor aspects, which are expressed in symbols, letters and sentences. The learning outcomes examined in this study are cognitive biology learning outcomes that include five levels, namely remembering (C1), understanding / understanding (C2), applying (C3), and analyzing (C4). Evaluate (C5) The instrument used to measure student learning outcomes on the cognitive aspects is a multiple choice test.

METHODS

This research was conducted at SMAN 3 Cilegon and SMAN 5 Cilegon on the learning of Biodiversity Class X class material in odd semester 2018/2019. The research method used in this research is Ex-Post Facto. The research design used was 2x2 factorial, consisting of 2 independent variables, namely: cognitive style (X1), and learning independence (X2), while the dependent variable was cognitive learning outcomes (Y).

Table 1. Research Design Effects of Cognitive Style and Learning Independence on Cognitive Learning Outcomes with Factorial 2x2

Independence Learning (B)	Cognitive Style (A)	
	Filed Independent (A_1)	Filed Dependent (A_2)
High Learning Independence (B_1)	A_1B_1	A_2B_1
Low Learning Independence (B_2)	A_1B_2	A_2B_2

Keterangan
A_1 = Cognitive Style FI
A_2 = Cognitive Style FD
B_1 = High Learning Independence
B_2 = Low Learning Independence
A_1B_1 = Learning outcomes of students who have high learning independence using the FI cognitive style.
A_2B_1 = Learning outcomes of students who have high learning independence using FD cognitive styles.
A_1B_2 = Learning outcomes that have low learning independence using the FI cognitive style.
A_2B_2 = Learning outcomes that have low learning independence using the FD cognitive style.

The selection of samples from the population uses a multistage random sampling technique with the following stages:
1. The first stage of determining the sample of schools by selecting high school by purposive sampling.
2. The second stage uses cluster random sampling techniques to determine the sample to be used as the object of research.
3. The third stage using simple random sampling technique was selected 156 samples from class X IPA with calculations using the Slovin formula.
4. The fourth step is to use the sample random sampling technique and then proceed using the Slovin formula.

Data collection techniques used in this study were questionnaire and cognitive tests. The instruments used to collect data are:
1. With a question test consisting of 50 multiple choice questions with 5 alternative answer choices namely a, b, c, d or e for learning outcomes test questionnaire
2. For the test of learning independence instrument used in the form of statements and has a scale value 1-5.
3. Cognitive style uses the Group Embedded Figre Test (GEFT) and has 2 assessment criteria according to Witkin; Raskin; Karp (1971) in Tiat (2007), namely: 0-9 categorized into fields dependent and 10-18 are categorized into independent fields.

Data processing techniques for normality test using the Kolmogorov-Smirnov test with a significance level $\alpha = 0.05$ (with SPSS application). Homogeneity test uses the Bartlett test with a significance level of $\alpha = 0.05$ (with SPSS application). Analysis of the research hypothesis using a 2x2 factorial ANAVA was followed by the Tukey test.

RESULT

Table 2. Statistical Descriptions of Cognitive Styles, Learning Independence, Learning Outcomes and Groups A1B1, A1B2, A2B1, A2B2

Variable	Statistics						
	n	Max Value	Min Value	Range	Average	Standard Deviation	Variance
Cognitive Style	156	15	2	13	7.53	3.49	12.24
Independence Learning	156	99	45	54	77.62	1.07	115.38
Learning outcomes	156	79	14	64	44	3.73	13.98
Group A1B1	15	68	32	36	48.27	10.44	109.06
Group A1B2	10	79	29	50	49.70	16.05	257.78
Group A2B1	27	79	29	50	47.89	14.64	214.33
Group A2B2	31	57	21	36	33.97	10.88	118.36

Table 3. Values of Cognitive Style in High School Students

	Group	N	Average Value Cognitive style	Average Value Learning outcomes	Standard Deviation
Cognitive Style	FI	45	12	43.24	1.79
	FD	111	6	44.41	1.72

Table 4. Value of Learning Independence of High School Students

	Group	N	Average Value Independence Learning	Average Value Learning outcomes	Standard Deviation
Independence Learning	High	90	85	44.53	6.1
	Low	66	67	43.03	7.26

Table 5. Two Way Annava Hypothesis Test Results

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	351.403[a]	3	117.134	9.184	.000
Intercept	11033.149	1	11033.149	865.078	.000
Cognitive Style	113.560	1	113.560	8.904	.004
Independence Learning	74.448	1	74.448	5.837	.018
Cognitive Style * Independence Learning	54.658	1	54.658	4.286	.042
Error	1007.560	79	12.754		
Total	13625.000	83			
Corrected Total	1358.964	82			

a. R Squared = .259 (Adjusted R Squared = .230)

Table 6. Calculation results using the Tukey test

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A1B1	A1B2	0.967	5.261	0.998	-12.8436	14.7769
	A2B2	15.4086	4.053	0.002*	4.7689	26.0483
A1B2	A2B1	1.81111	4.771	0.981	-10.9116	14.3338
A2B1	A1B1	-2.77778	4.150	0.908	-13.6715	8.1159
	A2B2	12.63082	3.392	0.002*	3.7259	21.5357
A2B2	A1B2	-14.44194	4.687	0.015*	-21.5357	-3.7269

DISCUSSION

The learning outcomes are then grouped into 4 groups based on cognitive style and learning independence. Based on Table 2 the group of student learning outcomes obtained the highest value of 79 out of a maximum value of 100, while the lowest value of 21. The average value of the highest student learning outcomes obtained in the group of students who have FI cognitive style and low learning independence that is equal to 49.70. While the average value of the lowest student learning outcomes obtained in the cognitive style group FD and low learning independence that is equal to 33.97.

Based on Table 3 that the results of this study indicate that students who have the cognitive style of FI and FD obtain different grades of learning outcomes. Student learning outcomes who have a cognitive style of FD have a higher value with an average of 44.41, than students who have a cognitive style of FI with an average of 43.24. This study is not in line with Malili (2018) which states that the learning outcomes of students who have a cognitive style of FD are lower than the learning outcomes of students who have a cognitive style of FI. This can be predicted because the learning process in the classroom is dominated by group discussion activities and practicum so that it tends to benefit groups who have a FD cognitive style. This is in accordance with the statement of Nugraha and Awaliyah (2016) practicum and group discussion can improve learning outcomes in students who have FD cognitive style.

One of the characteristics of students who have a FD cognitive style is that they tend to follow existing goals, and tend to prioritize external motivation and external reinforcement such as praise and gift giving. In addition, the value of FD learning outcomes is higher than the FI predicted, possibly because students with the cognitive style of FD prefer to work on the type of easy questions first.

Based on research conducted low learning outcomes may be due to the selection of classroom learning methods that are less varied so that it does not accommodate differences between the cognitive styles of students in this case the cognitive styles of FI and FD. Gina (2016) distinguishes the learning process between FI and FD students, students who have FI cognitive style can work together both groups and individuals while students who have FD cognitive style can work together in groups because of the support of their social environment. This is in line with Shi's (2011) research that cognitive style has a significant influence on a student's learning strategy.

The test results show that there is an influence of cognitive style on student learning outcomes (Table 5). This is consistent with the research of Lamba (2006) that there is an influence of cognitive style on learning outcomes. The research shows that cognitive style has an influence on student learning outcomes. Cognitive style can be interpreted as a way for students to capture information, process information and execute information in an action. Cognitive style is one of the significant factors that influence student learning outcomes. Strengthened by the statement Suryanti (2014) that cognitive style has a significant effect on learning outcomes.

Based on the analysis results in Table 4 shows that high learning independence produces high learning outcomes while low learning independence will produce low learning outcomes. This high student learning independence is one of the factors that can influence student learning outcomes and play

an important role in the learning process. The influence of the level of student learning independence will make students responsible for achieving learning goals. This is because learning independence is the ability of students to carry out the process of learning activities of their own volition without coercion from others.

Table 5 shows the significant influence of learning independence on student learning outcomes. These results are consistent with Saefullah (2013) research that learning independence has a positive relationship with learning outcomes. Learning independence can be seen from the learning process in the classroom. Independence of learning as a process can be interpreted as students having the responsibility in achieving learning goals without coercion from other people, teachers or friends. This study is in line with the statement of Egok (2017) and Bungsu et.al (2019) that learning independence has a positive effect on student learning outcomes.

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To develop learning independence in students, the teacher is advised to create a conducive learning atmosphere, help students understand methods and procedures for completing assignments, and encourage students to be able to control emotions and not easily panic when experiencing difficulties in working on assignments. According to Haryono (2001) independence needs to be given to students so that students have a sense of responsibility in organizing and disciplining themselves to develop learning abilities of their own volition without coercion.

Based on the results of the study (Table 5) there is an interaction between cognitive style and learning independence on learning outcomes. This is in accordance with research Rijal (2015) that there is a positive relationship between student learning independence with learning outcomes and cognitive learning styles with student learning outcomes.

The Tukey test table (Table 6) shows that there are significant differences between groups. Learning groups that have interactions between cognitive style and learning independence of learning outcomes are groups A1B1 with A2B2, A2B1 with A2B2, and A2B2 with A1B2. This is seen from the level of sig. <0.05. Interactions obtained between these variables are inseparable from the factors that influence learning outcomes.

Cognitive style and learning independence are one part of the many variables that can affect student learning outcomes. The learning process is a learning system that automatically occurs in individuals. The task of an educator is how to teach someone with good quality that can improve the quality of education.

CONCLUSION

This research was conducted to prove whether there is an influence of cognitive style and learning independence on high school student learning outcomes on Biodiversity material. The sample in this study was high school students of class X IPA of SMAN 3 Cilegon and SMAN 5 Cilegon, the research sample of 156 students.

Based on the results of research that has been done, it can be concluded that there is an influence of cognitive style on student learning outcomes on Biodiversity material, there is an influence of learning independence on student learning outcomes on Biodiversity material, and there is an interaction between cognitive style and learning independence on student learning outcomes in Biodiversity material.

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