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The effect of implementation of ITG-DIA learning model on critical thinking ability and reaction rates learning result on chemistry students of Tadulako University

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Abstract
The method used in this research was quasi-experimental method, which involves two classes, namely class A as an experimental class that was taught with ITG-DiA learning model and class C as a control class that was taught with a guided inquiry model. The purpose of implementing ITG-DiA model is to determine the effect of model on critical thinking skills and learning outcomes. The research instruments consisted of a critical thinking test with five essay question items, an affective assessment questionnaire, and a psychomotoric assessment questionnaire sheet. The instruments were validated by experts before being used. The results of validation of critical thinking tests were obtained test validity from 0.37 to 0.69. The results of the affective and psychomotor assessment questionnaire validation were valid. The results obtained an average value of critical thinking skills in experimental class were 87.11 and 79.44 in control class. The average values of learning outcomes were obtained 87.86 in experimental class and 82.58 in control class. In general, critical thinking skills and learning outcomes have increased. The improvement of learning outcomes and critical thinking skills have significant differences. The non-parametric test result of Mann Withney test was obtained Asymp. sig value < 0.05 or, 000 < 0.05, indicating that the critical thinking skills and learning outcomes of the two samples are different. Based on the differences in the results, it can be concluded that the application of ITG-DiA learning model affects the ability of critical thinking and learning outcomes.

Keywords: learning-model, teaching-learning, ITG-Dia, learning-outcome

1. Introduction

The test result of the critical thinking skills try out of Chemistry students in semester V at FKIP Tadulako University reached the highest score of 80.8% and the lowest of 48.1% of all assessment criteria with overall average score of 64.6% (Afadil, 2013) [1]. Critical thinking skills are the combination of abilities, knowledge, attitudes, skills and processes (Johnson, 2002) [9]. Critical thinking skills of students can be improved through classroom learning as learning is the impact of thinking (Eggen and Kauchak, 2012) [6].

The low learning outcomes of basic Chemistry provides an illustration of the weak of concept and critical thinking skills mastery of the students in basic Chemistry matter, allegedly related to the learning process, covering the selection of learning models. Learning models which do not facilitate students to develop critical thinking skills result in low learning outcomes. Inquiry learning can improve critical thinking skills (Hairida, 2016) [11]. Ni'mah (2014) [18] states that guided inquiry-based learning can improve student learning outcomes. Another factor is assumed to be the cause of the low learning outcomes is learning that does not pay attention to students' learning styles. If the teaching and learning styles and students' learning styles are appropriate, then, the information conveyed tend to be rejected. Suyono and Hariyanto (2012) [20], suggest that teachers need to integrate their teaching styles with student learning styles. Knowing students'learning styles as a consideration for selecting media (Franzoni & Assar, 2009) [8]. Students' learning styles affect learning outcomes (Utami and Gafur (2015) [21].

The result of learning styles analysis of students at Chemistry education study program using a learning style questionnaire is adopted from Felder & Solomon (1993) [7] of 32 students, 41% with active dimension learning styles, 28% of sensory dimension, 19% of visual dimension, 6% of verbal dimension and 6% of global dimension. The results of the analysis show that the students taking part in dominant learning have active dimension learning styles. Therefore, this research focuses on the active dimension learning styles.

The research aims to determine whether or not the application of guided inquiry learning model with active dimension learning styles (ITG-DIA) affect the ability to think critically and students' learning outcomes. The learning stage follows guided inquiry model by adapting the learning style to the active dimension at each learning stage.

2. Research Method

The method used in this research was a quasi-experimental method, which involves two classes, namely class A as an experimental class that is taught with ITG-DiA learning models and class C as a control class that is taught with a guided inquiry model. The purpose of implementing the ITG-DiA model is to determine the effect of model on critical thinking skills and learning outcomes. The testing phase of the model uses a one group pretest-posttest design (Frankel & Wallen, 2007), as shown in Figure 1, where before learning is given pretest and after learning given posttest.

Pre-Test	Treatment	Post-Test
O1	X	O2

Explanation: O1 = Pre-Test, X = Learning with ITG-DiA model, O2 = Post-Test

The instruments used in this research were lesson plans, students' work sheets, critical thinking skills test, attitude assessment questionnaire and skills assessment questionnaire. The measurement instruments used in previous studies have validated the contents and constructs by five validators and are suitable to use.
The measurement of critical thinking skills used a critical thinking test consisting of five items that have been validated and have validity value of 0.37 to 0.69 and a reliability co-efficient of 1.25. Learning outcomes are calculated using learning achievement test scores, attitude questionnaires and skills assessment questionnaires. The proportion of each domain is 50% of the cognitive learning test, 30% of the affective domain and 20% of the psychomotor domain (Kamaludin *et al*., 2014).
Hypothesis testing used a non-parametric test adopted from Mann Withney test because the prerequisite test for normality and homogenity tests show the data are not homogeneous and not normally distributed (Suyanto and Gio, 2017) [19]. The increasing of critical thinking skills and students' learning outcomes after participating in learning through the application of the ITG-DiA model are determined using the normalized gain (g) equation (Hake, 2002) [13].

$$g = \frac{\%\ skor\ posttes - \%\ skor\ pretes}{100 - \%\ skor\ pretes}$$

Category of g: 1) learning with high gain (high-g), if g ≥ 0.7; 2) learning with "medium gain" (medium-g), if 0.7 > g ≥ 0.3; dan 3) pembelajaran dengan "low gain" (low-g), if g < 0,3.

3. Result
3.1 Identification of Learning Styles
Before implementing the ITG-DiA model to the experimental class, identification of learning styles was first carried out using a learning style questionnaire. The results of identification are presented in Figure 2. The results of identification of learning styles as a guide in conducting the division of learning groups.

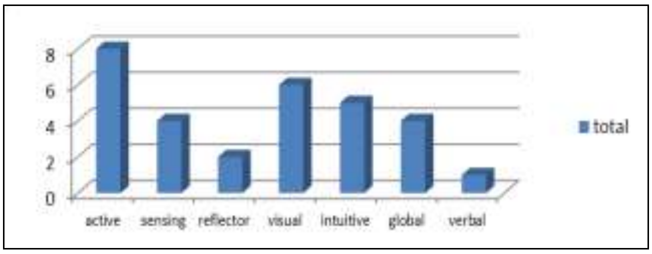

Fig 2: Learning Style Identification Results

The results show that 30 students who took the learning style test, eight learning styles were identified and the dominant dimension of learning style was active. Students with this active dimension learning style are spread into six groups.

3.2 The implementation of TTG-DiA learning model
Data on assessment of the ITG-DiA model feasibility in the experimental class is presented in Table 1

Table 1: The result of experiment learning class implementation

No	Activity of Students or Lecturers	Average	Criteria	Implementation of Learning	Category
1	Identification of problem	3.65	Very good	91.15%	High
2	Make a hypothesis	3.58	Very good	88.40%	High
3	Design an experiment	3.50	Very good	87.50%	High
4	Conduct an experiment	3.81	Very good	95.31%	High
5	Analyze data	3.63	Very good	90.11%	High
6	Make conclusions	3.94	Very good	98.44%	High

Explanation: The Activity of Students or Lecturers in each aspect of observation is very good (3, 5-4, 00); High learning performance (80.1% - 100%)
Table 1 shows that the implementation of learning using ITG-DiA learning model run very good with the implementation of learning categorized high. Based on the observation of the implementation of learning in Table 1, it can be concluded that ITG-DiA learning model can be implemented in learning, especially chemical kinetics.

3.3 Assessment of the Psychomotoric and Affective Domains
The data on psychomotoric and affective values of students were obtained from the observation result conducted by two lecturers in the experimental and control classes. The average observation result of the psychomotor and affective domains are presented in Tables 2 and 3.

Table 2: Psychomotoric average score of each assessment aspect

Class	Rata-rata nilai pada setiap aspek penilaian						X	N	P
	Problem formulation	Make a hypothesis	Use of Tools	observat ion	Skill in Presenting Observation Results	Conclusion			
E	85.69	90.00	92.64	90.28	89.03	100.00	91.27	A	VG
K	83.61	88.19	91.11	82.92	84.44	97.64	87.99	A	VG
X	84.65	89.10	91.87	86.60	86.73	98.82	89.63	A	VG

Explanation: E = experiment, K = control, X = average, score, N = value (85.01-100 = A), P = predicate (80.01-100 = very good), VG = Very Good

Data of Table 2 shows that from the six psychomotoric aspects assessed, is obtained an average value of A with a very good predicate.

-100 = very good), VG = Very Good

Data Table 3 shows that from the five affective aspects assessed, it is obtained a very good predicate for A average score.

3.4 Cognitive Assessment
Cognitive domain data is obtained from the results of critical thinking skills tests. The average score result of critical thinking skills test is presented in

Tabel 4: The average score of critical thinking skills

Class	Average Critical Thinking Value of Each Item					X	N	P
	1	2	3	4	5			
E	96.67	90.00	93.33	92.22	63.33	87.11	A	SB
K	85.56	91.11	91.67	72.22	56.67	79.44	B^+	B
X	91.11	90.56	92.50	82.22	60.00	83.28	A^-	SB

Based on Table 4, it can be seen that the average score of the critical thinking skills of the B^+ control class and the experimental class A.

3.5 Students' Learning Outcomes
Learning outcomes data were obtained from the cognitive, affective and psychomotoric domains. The results of data processing are presented in Table 5. Learning outcomes data before and after implementing of the learning model is presented in Figure 2.

Table 5: The Average Score of Students' Learning Outcomes

Class	Pre-test	Average Value of Each Aspect			Learning Outcomes	N	P
		Affective	Psychomotoric	Cognitive			
E	32.40	86.83	91.27	80.90	87.86	A	SB
K	32.00	84.21	87.99	73.32	82.58	A^-	SB
X	32.20	85.52	89.63	83.28	85.22	A	SB

Data Table 5 shows that the learning outcomes of the students in experimental class are 87.86 with A grades and control class 82.58 with A^- grade.

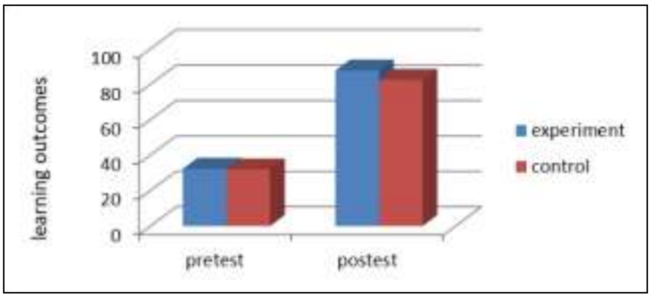

Fig 3: Chart of learning outcomes Before and After implementing the Model.

Figure 3 shows a significant increase in learning outcomes in both the experimental class and the control class, but the increase in learning outcomes in the experimental class is higher.

3.6 Hypothesis testing
Hypothesis testing used non-parametric test statistical tests, namely using the Mann Withney Test. Mann Withney test result obtained Asymp.sig values <0.05 or 000 <0.05. Based on the results of the Withney test it can be concluded that the research hypothesis has a significant difference in the learning outcomes of students taking part in the guided inquiry learning model and the ITG-DiA model is accepted.

Testing the increase of learning outcomes is calculated using Hake 2002 equation, the result of learning outcomes is presented in Figure 4.

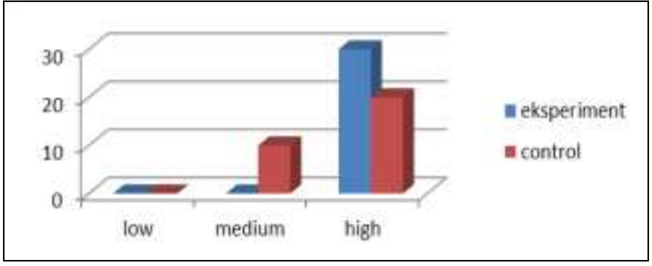

Fig 4: Chart of n-gain values of the experimental class and the control class

4. Discussion
The initial stage of the ITG-DiA model is the students identifying problems individually. Gagne et.al. (Slavin, 2008) state that students' initial knowledge contributes to the formation or understanding of knowledge. This is in accordance with Marsh's opinion, which states that each student has their own learning style (Suyono & Hariyanto, 2012) [20], so it is important for teachers to understand the learning styles of their students (Danim & Hairil, 2014) [5].

Increasing the ability of students in designing experiments cannot be separated from the role of students with an active dimension of learning styles and the role of lecturers in understanding student learning styles. This is consistent with initial statement (2014) that in the classroom teachers should be able to modify their teaching styles and adapt to students' learning styles. Students with an active dimension of learning style can have the ability to affect other students in the group to be active in designing experiments and discussing the results of experimental design. This is in line with the statement of Narayani (2014) [16] that students with an active dimension of learning style have strong learning abilities, because the learning process of those who learn by doing it themselves, through involvement in physical activity or discussion. Hanafiah & Suhana (2009) [10] state that by maximally involving students' abilities, they find their own knowledge, attitudes and skills, as a form of behavior change. Muijs & Reynolds (2008) [15], also state that discussion activities can increase the involvement of students in the learning process and provide opportunities for students to think about a matter then verbalize their thinking. new concepts or skills by concluding. The recommendation (conclusion) formulated by students will be more meaningful if there are more relationships between existing knowledge and new ones (Aydin & Boz, 2013) [4].

The assessment result of critical thinking skills in the experimental class and control class in Table 4 have increased. The increasing of critical thinking skills in both classes have significant differences, this is due to the role of the students with an active dimension of learning styles that are spread across each group that can affect the other students in the group to play an active role in learning. This result is also supported by the results of observation of psychomotoric aspect (Table 2), the average score of each aspect of psychomotoric observation for the experimental class is higher. Similarly, the average score of the students' attitude, the attitude observation result in Table 3, the average attitude of the students in the experimental class is higher.

The students' learning outcomes in Table 5 and Figure 2 show that the average experimental class learning outcomes differ significantly from the control class. The differences in learning outcomes occur because the average students' activity in the experimental class both in psychomotoric and affective domains is higher. The adaptation to students' learning styles affect the increase of learning outcomes. This is in accordance with the research conducted by Utami and Gafur (2015) [21]; Ishak & Awang (2017) [12] that learning styles affect learning outcomes, there is a significant relationship between learning styles and students' achievement.

Learning with ITG-DiA model is a learning use the guided inquiry model by incorporating aspects of the active dimension learning style at each stage of guided inquiry. The aim is besides focusing on the implementation of guided inquiry, there is also an adaptation to the way the students learn. This is in accordance with the research of Franroni & Assar (2009) [8], in addition to resources to support the learning process, it is necessary to adjust to the characteristics of each student.

Based on the learning activities of the students and lecturers in each learning stage implementing the guided inquiry model, but in the experimental class there is an adaptation to the students' learning style. The adaptation is done by putting the students with an active dimension of learning styles into each group. In the experimental class, each group contained the students with active dimension learning styles. These students play active role and cooperate with group members working on the tasks presented in the students; worksheets. The active students tend to be always active and understand the best information by doing it themselves. In addition, they tend to be interested in communicating with others and learning in groups to discuss the material that has been learned (Danim & Khairil, 2014) [5].

The learning outcomes presented in Figure 3, show that both classes have increased their learning outcomes after joining the learning process. The increase of students' learning outcomes in control class with n-gain values is in the medium and high criteria, whereas in the experimental class, the increase in learning outcomes were all at the high criteria. Overall student learning outcomes in the experimental class and the control one have increased, but the increase in learning outcomes in the experimental class is higher.

The result of the analysis of the hypothesis test using the Mann Withney test, obtained Asymp.sig value <0.05 or, 000 <0.05. Based on the result of the Mann Whitney test, it can be concluded that the learning outcomes of experimental class through the illumination of the ITG-DiA model differ from those of control class who learn through the implementation of the guided inquiry model.

5. Conclusion

The implementation of learning model in this research used a guided inquiry learning model in the control class and experimental class using a guided inquiry learning model with an active dimension learning style (ITG-DiA). The implementation of ITG-DiA model in experimental class run very well with high criteria. These results identify that the ITG-DIA model is practically implemented in the learning. It is consistent with the expert opinion that the practicality of a product (learning model) developed is real and easily applied. (Nieveen 2007; Arikunto (2012).

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