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Differences in the Ability to Understand Mathematical Concepts of Students Taught by Using Guided Discovery Learning and Contextual Teaching and Learning Models Assisted by Autograph Software Viewed from Student Learning Styles

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Abstract This study aims to determine (1) whether the ability to understand mathematical concepts of students taught by Guided Discovery Learning (GDL) assisted by Autograph Software is higher than students taught by Contextual Teaching and Learning (CTL) assisted by Autograph Software, (2) whether the ability students' understanding of mathematical concepts in the convergent learning style group is higher than that of the divergent learning style group. This type of research is a quasi-experimental study with a research population of all grade X students of Parulian 1 Medan Private High School. This study uses 2x2 two-way ANAVA. Then proceed with the t test to see whether the two groups differ significantly. Based on the t test statistical calculations and confirmed with spss, it can be concluded that (1) The ability to understand mathematical concepts of students taught by Guided Discovery Learning (GDL) assisted by Autograph Software is higher than students taught by Contextual Teaching and Learning (CTL) with Software Autograph, (2) The ability to understand students' mathematical concepts in the convergent learning style group is higher than that of the divergent learning style group.

Keywords: *contextual teaching and learning, guided discovery learning, concept understanding ability, autograph software*

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1. Introduction

Understanding concepts is one of the basic abilities that is very important and must be possessed by every student in learning mathematics. Based on the 2013 Curriculum, one of the objectives of giving mathematics at the secondary school level is for students to understand mathematical concepts. Understanding mathematical concepts includes competence in explaining inter-concept interrelations and using concepts or algorithms flexibly, accurately, efficiently and precisely in problem solving, as in [1].

The importance of understanding the concept can also be seen from the statement of [2], that mathematical understanding is very important in learning mathematics because it will facilitate the solving of mathematical problems. Which, as said [3] that, each student must have a particular problem-solving abilities in solving problems or questions given by the teacher. Understanding the concept also acts as a bridge or link between the previous concept with the concept that will be studied in the next material. The importance of understanding other conceptual abilities was revealed by [4], that students who have a better understanding of mathematics will be able to compete in the economic world. The ability to understand concepts is very important to be developed in every student in the learning process.

But in reality, mathematics learning does not involve optimal student activity in terms of increasing understanding of mathematical concepts. Factors that also need to be considered to improve student achievement, as in [5] that, classroom and school condition are viewed as essential factors to students achievement. Reference [6] that the Principal as a leader, a role leading the school in order to empower the school resources optimally, to be able to develop and implement the school's vision and feel school as theirs. Good management of academic program focused on students' success into learning process, began with planning, organizing, performing, controlling must depend on students' learning necessessity, as in [7]. So, one way

that can be done is to change the conventional learning model commonly used in schools with a learning model that requires students to be more active and get the opportunity to explore their abilities. The solution is to implement Guided Discovery Learning (GDL) and Contextual Teaching and Learning (CTL). Guided Discovery Learning is also known as guided discovery learning which can be used to improve students' understanding of mathematical concepts. Reference [8] explains that Guided Discovery Learning is a discovery learning method where the teacher guides students through activities by asking questions and directing students to discussion. Furthermore, contextual learning or Contextual Teaching and Learning (CTL) is a solution to link learning material and the real environment of students. Contextual teaching is teaching that reinforces, expands and applies students' academic knowledge and skills in order to solve real-world problems, as in [9].

In addition to the learning model, one of the factors that is no important in determining student learning success is the learning style of students. Reference [10] in his book The Kolb Learning Style Inventory 4.0 suggests learning styles illustrate a unique way of spiraling through the learning cycle based on their preferences. Kolb developed four learning styles namely: Divergent, Assimilation, Convergent, and Accommodation.

People with divergent learning styles, see concrete opportunities from various angles. Their attitude towards the situation is more than watching; people with an assimilation learning style, have a great opportunity in obtaining and understanding enormous information and combining it in the right way; people with convergent learning styles, have the greatest efficiency in applying theory and thinking scientifically and have better performance in solving problems and planning structures; and people with accommodation learning styles enjoy hands-on and instructive experiences and challenging works, they are quite capable of doing work and planning and accommodation with new conditions. Students generally have one of these four learning styles. Furthermore, in this study what will be compared is convergent and divergent learning styles. This selection is based on the dominant number of students who get convergent and diverg learning styles in each class.

In this research, Guided Discovery Learning and Contextual Teaching and Learning will be taught by using autograh software. Autograph is a special program used in secondary level mathematics learning, and its design involves the main principles in learning and learning namely flexibility, repetition and drawing conclusions. Autograph has the ability to draw 2D and 3D graphics for topics such as statistics, transformations, cone sections, vectors, slope, and derivatives. In its application, users can observe how functions, equations and graphs are formed. Autograph also allows to change and animate graphics, gradients, shapes or vectors that have been planned for derstanding the material. Thus, the application of Guided Discovery Learning (GDL) and Contextual Teaching and Learning (CTL) assisted by Autograph software in terms of learning styles is expected to overcome student difficulties in developing students' understanding of mathematical concepts.

2. Literature Review

2.1. Ability to Understand Mathematical Concepts

The ability to understand mathematical concepts is the ability/competency shown by students in understanding the definition, understanding, special characteristics, nature, core/content of a mathematical material and competence in performing procedures (algorithms) in a flexible, accurate, efficient and precise manner.

Indicators of understanding mathematical concepts used in this study are: (a) defines concepts verbally and in writing, (b) make examples and not examples of concepts learned, (c) presenting concepts in various forms of mathematical representation (tables, graphs, diagrams, sketches, mathematical models or other means), (d) identify the properties of a concept and recognize the conditions that determine a concept, (e) linking various concepts in mathematics and outside mathematics, (f) use concepts or algorithms in problem solving.

2.2. Guided Discovery Learning Model

Guided Discovery Learning is a learning that develops the way students actively learn in finding and investigating their own concepts through guidance, instructions, direction or questions given by the teacher.

Guided Discovery Learning is a student-centered learning model through teacher guidance consisting of the following stages: Stimulation (stimulation/stimulation), blem Statement (statement or problem identification), Data Collection (data collection), Data Processing (data processing), Verification (proof), and Generalization (drawing conclusions/generalizations).

2.3. Contextual Teaching and Learning

Contextual Teaching and Learning is learning in which there is a process of linking material / concepts learned in school with the real world situation of students, so that in these activities encourage students to connect the knowledge they have with the application in their daily lives.

As fo e seven main components in contextual learning, namely: constructivism (constructivism), asking questions (questioning), inquiry (inquiry), learning communities (learning community), modeling (mo ng), and authentic assessment (authentic assessment).Guided Discovery Learning is a learning that develops the way students actively learn in finding and investigating their own concepts through guidance, instructions, direction or questions given by the teacher.

3. Research Method

This research is a quasi-experimental study (quasi experiment) and uses a quantitative approach. The design of this research is Post Test Only Control Design. In this design there are two groups chosen randomly. The first

group was taught by the GDL model called Experiment I and the second group was taught by the CTL model called Experiment II. The experimental design used is factorial design. 2x2 factorial designs are used, such as Table 1 following:

Table 1. Factorial Design

Models Style	Konvergen (K)	Divergen (D)
Guided Discovery Learning (G)	GK	GD
Contextual Teaching and Learning (C)	CK	CD

4. Research Result

The data analyzed were student learning style questionnaires and tests of students' understanding of mathematical concepts. Then an analysis of the questionnaire and the test was carried out with a two-way analysis of variance (ANAVA). The test results provide information about students' mathematical concept comprehension after learning, both in Experiment I class through Guided Discovery Learning assisted by Autograph Software and in Experiment II class through Contextual Teaching and Learning (CTL) assisted by Autograph Software.

4.1. Description of Student Learning Styles

Student learning style questionnaire is given to know and classify students based on learning styles, namely divergent, convergent, assimilation and accommodation, before being given treatment in the form of learning models. This learning style questionnaire consisted of 10 questions, where the questionnaire was equipped with 4 answers for each question. So, from the 4 answers available, students must give a score on each answer available. This instrument is used to reveal student learning style variables. This learning style questionnaire was adopted from Kolb's Learning Style Inventory. In this study, the sample used was students with convergent and divergent learning styles, because the numbers were dominant in each class. So the total sample in each Experiment class is presented in Table 2 below:

Table. 2 Results of Student Learning Style Questionnaire for Experiments Class I and II Class

Class / Learning Style	Experiment I Number of Student	Experiment II Number of Student	Total Number of Student
Konvergen	10	11	21
Divergen	6	8	14
Total	16	19	35

Based on Table 2 above, it can be concluded that the most learning styles in each class are convergent learning styles, then the second sequence is divergent learning styles. The tendency of students with convergent learning styles implies that students are able to solve problems and make decisions effectively, preferring to deal with problems and technical tasks rather than social and interpersonal issues. And in formal learning situations, students tend to experiment with new ideas, simulations, laboratory assignments, and practical applications.

Furthermore, to continue testing the learning style questionnaire data on the two-way ANAVA, the samples for the convergent and divergent learning styles must be tested for requirements, namely tests for normality and homogeneity. Based on the Kolmogrov-Smirnov test using SPSS, it was concluded that the sample came from a normally distributed population. Furthermore, with the Levene-test it was concluded that the variance in the ability of understanding concepts between students who have convergent and divergent learning styles is the same.

4.2. Description of Students' Mathematical Concept Understanding Ability (MCUA)

Student KPKM test is performed once against students, namely by providing a post-test at the end of learning. The number of students who took the post-test were 16 people in Experiment I class who got Guided Discovery learning assisted by Autograph Software and 19 people in Experiment II class who received Contextual Teaching learning assisted by Autograph Software. Quantitatively, the level of ability to understand students' mathematical concepts can be seen in Table 3, below:

Table 3. Post-test Ability of Understanding Mathematical Concepts of Experimental Class Students I

No.	Interval Value	Number of student	Percentage	Rating Categories
1.	$0 \leq MCUA < 45$	0	0 %	Very Poor
2.	$45 \leq MCUA < 65$	1	6,25 %	Less
3.	$65 \leq MCUA < 75$	1	6,25 %	Sufficient
4.	$75 \leq MCUA < 90$	12	75 %	High
5.	$90 \leq MCUA < 100$	2	12,5 %	Very High

Based on the information in Table 3, it can be seen that the highest score acquisition is in the range of values from 90 to 100 with the number of students as much as 2 people or at 12.5%. As for the lowest score acquisition is the range of grades 45 to 65 with the number of students as much as 1 person or 6.25%. Based on the post-test results obtained the lowest score (Xmin), highest score (Xmax), average score (X-average) and standard deviation (s) for Experiment I and Experiment II classes as shown in Table 4 below:

Table 4. Post-test Results Data

Class	N	X_{maks}	X_{min}	$\bar{X}$	S
Experiment I	16	91	56	79,06	8,606
Experiment II	19	91	50	69,95	12,044

From Table 4, it can be concluded that the average post-test ability of understanding mathematical concepts of students in Experiment I and Experiment II classes are different. And the average post-test score in Experiment I class is higher than that of Experiment II class. To test the hypothesis, first test the normality and homogeneity of the post-test in each study. Based on the Kolmogrov-Smirnov test using SPSS, it was concluded that the results of the

ability to understand students' mathematical concepts in Experiment I and Experiment II classes were normally distributed. Furthermore, with the Levene-test it was concluded that the results of the ability to understand the mathematical concepts of students in Experiment I and Experiment II classes were homogeneous.

4.3. Hypothesis Testing

To test the whole hypothesis is done using the ANAVA test. ANAVA is one of the univariate that can be used to determine differences in students' abilities and the description of the interaction of two factors with one dependent variable that is of type interval or ratio and several independent variables of type nominal or ordinal.

After testing the data requirements, namely the normality and homogeneity of the data, the data will be analyzed using two-way ANAVA. Linear models of research experiments for students' understanding of mathematical concepts are, as in [11].

$$Y_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{kij};$$
$$i = 1, 2; \; j = 1, 2; \; k = 1, 2, \ldots$$

Information:

Y_{ijk} is a score of the ability to understand the mathematical concepts of the k-th student, in the i-learning style, which gets j-learning.

μ is the average score of students' actual understanding of mathematical concepts

α_i is the additive effect of the i-th learning style

β_j is the additive effect of the jth learning model

$(\alpha\beta)_{ij}$ is the interaction effect of the i-th learning style and the j-learning

ε_{kij} is the effect of experimental deviations from the k-th student score, on the i-learning style, which gets the j-learning model.

4.3.1. Hypothesis Test I

After the test requirements have been met, it will proceed with the hypothesis test I by using two-way ANAVA. In the hypothesis I test is to test the effect of GDL and CTL learning models assisted by autograph software on the ability to understand students' mathematical concepts. The test criteria are Reject Ho if the value of sig. <0.05. Testing is done based on hypothesis I, namely:

Ho: There is no influence of Guided Discovery Learning and Contextual Teaching and Learning on the ability to understand students' mathematical concepts

H_1: There is an influence of Guided Discovery Learning and Contextual Teaching and Learning on the ability to understand students' mathematical concepts

Statistically, the hypothesis can be formulated as follows:

H_o: $\beta_1 = \beta_2 = 0$

H_1: There is at least one j, such that $\beta_j \neq 0$.

Information :

β_1: influence of Guided Discovery Learning. on the ability to understand students' mathematical concepts

β_2: the influence of Contextual Teaching and Learning. on the ability to understand students' mathematical concepts.

The results of two-way ANAVA test calculations to test Hypothesis I, were confirmed with SPSS statistics 25, with sig values. amounted to 0.014. Because the value (sig.) <0.05, then Ho is rejected. Thus, it can be concluded that there is an influence of Guided Discovery Learning and Contextual Teaching and Learning on the ability to understand students' mathematical concepts.

4.3.2. Hypothesis Test II

Hypothesis II that will be tested in this study is the influence of convergent and divergent learning styles on the ability to understand students' mathematical concepts. The test criteria are Reject Ho if the value of sig. <0.05. Testing is done based on hypothesis II, namely:

H_o: There is no influence of convergent and divergent learning styles on the ability to understand students' mathematical concepts

H_1: There is influence of convergent and divergent learning styles on the ability of students to understand mathematical concepts

Statistically the hypothesis can be formulated as follows:

H_0: $\alpha_1 = \alpha_2 = 0$

H_1: there is at least one i, such that $\alpha_i \neq 0$

Information:

α_1: the effect of convergent learning styles on the ability to understand students' mathematical concepts

α_2: the influence of divergent learning styles on the ability to understand students' mathematical concepts

The results of two-way ANAVA test calculations to test Hypothesis II, have been confirmed with SPSS statistics 25, with sig values. 0.003. Because the value (sig.) <0.05, then Ho is rejected. Thus, it can be concluded that there is an influence of student learning styles on the ability to understand students' mathematical concepts.

4.3.3. T-Test Ability of Understanding Mathematical Concepts between Learning Models

Further tests were carried out using the t test with the help of SPSS. Further tests were conducted to determine whether the ability to understand mathematical concepts of students who were given Guided Discovery Learning (GDL) learning significantly differed from Autograph-assisted Contextual Teaching and Learning (CTL). Based on testing with SPSS, the value of sig (2-tailed) < 0.05, or 0.016<0.05. This shows that there is a significant difference between the ability to understand mathematical concepts of students in the class who get GDL and CTL learning. Furthermore, because the class is a homogeneous class, with an average ability to understand mathematical concepts of students who get GDL learning is 79.06, while smaller CTL classes are 69, 95, it can be concluded that the ability to understand mathematical concepts of students taught by the Guided Discovery Learning (GDL) model assisted by Software Autograph is higher than the Contextual Teaching and Learning (CTL) assisted by Software Autograph.

4.3.4. T-Test Ability to Understand Mathematical Concepts between Learning Styles

Further tests were carried out using the t test with the help of SPSS 25 software calculations. Further tests were carried out to determine whether the ability of understanding the mathematical concepts of students in

convergent learning style groups differed significantly from groups of students who had divergent learning styles.

Based on the SPSS test, the si 2-tailed) value <0.05, which is 0.004 <0.05. This shows that there is a significant difference between the ability to understand students' mathematical concepts in the convergent and divergent learning style groups. Furthermore, because the group is a homogeneous group, with an average ability of understanding students 'mathematical concepts for convergent learning yles is 78.48, while the smaller divergent groups is 67.57, it can be concluded that the ability to understand students' mathematical concepts with convergent learning styles higher than divergent learning styles.

5. Discussion

5.1. Ability to Understand Mathematical Concepts of Students Taught by the Autograph Assisted GDL Model is higher than the Autograph Assisted CTL Model

Guided Discovery Learning (GDL) is a learning model that develops the way students actively find themselves and investigate for themselves the concepts to be learned. Through this Guided Discovery Learning model, students are taught to use ideas, concepts, and skills they have learned to find new knowledge and increase understanding of an issue, topic or issue with the teacher's knowledge as a facilitator. Through this Guided Discovery learning, the results obtained by students will last long in memory and will not be easily f otten.

In this model, students are encouraged to think for themselves, analyze themselves so they can find general principles based on the material or data provided by the teacher. Guided Discovery Learning Model is a discovery learning model that is implemented by students based on the teacher's instructions. The instructions given are generally in the form of guiding questions.

Whereas Contextual Teaching and Learning is learning in which there is a process of linking material/concepts learned in school with real-world situations of students, so that the activity encourages students to connect their knowledge with application in their daily lives. This learning also trains students to use their knowledge to solve new problems that they have never encountered before. Contextual learning also makes the student experie e relevant and meaningful.

The ability to understand mathematical concepts is the ability/competency shown by students in understanding the definitions, understandings, special characteristics, nature, essence / content of a mathematical material and competence in performing procedures (algorithms) in a flexible, accurate, efficient and precise manner. The indicators of students' understanding of mathematical concepts are as follows: (1) Defining concepts verbally and in writing, (2) identifying and making exa les and not examples of the concepts being studied, (3) presenting concepts in various forms of mathematical representation (tables, graphs, diagrams, sketches, mathematical models or other ways), (4) identify the properties of a concept and recognize the conditions that determine a concept, (5) link various concepts in mathematics and outside mathematics, (6) apply concepts or algorithms in problem solving.

Based on testing the statistical hypothesis I conducted shows that there are d rences in the influence of learning models on the ability to understand students' mathematical concepts. In other words, the ability to understand students' mathematical concepts taught by Guided Discovery Learning assisted by Autograph Software is different from Contextual Teaching and Learning assisted by Autograph Software. Where, the average value of students' understanding of mathematical concepts for lea g GDL is 79.06 while for CTL learning is 69.95. So it can be concluded that the ability to understand mathematical concepts of students taught by Guided Discovery Learning assisted by Autograph Software is higher than that of Contextual Teaching and Learning assisted by Autograph Software.

There are several factors that cause the ability to understand the mathematical concepts of students taught with Guided Discovery Learning assisted by Autograph Software higher than that of Contextual Teaching and Learning assisted by Autog ph Software, including that in the process of discovery students have the opportunity to be actively involved in learning. The fact shows that, the participation of many students in learning increases hen the findings are used. Through discovery learning, students learn t find patterns in concrete and abstract situations. And some facts that show that the skills of concepts and principles learned through discovery are more meaningful. So that through the discovery of concepts made by these students will make it easier to make transfers to new learning situations. This shows that learning with this discovery is very good for improving st ts' understanding of mathematical concepts.

The results of this study are also strengthened by the results of the [12], [13], and [14]; which concl d that learning by discovery or Guided Discovery Learning has a good effect on the ability to understand students' mathematical concepts.

In addition, learning with this discovery uses ICT in the form of Autograph software that will help students understan e mathematical concepts being studied. This statement is in line with the results of [15] research which shows that learning assisted by autograph software influences students' mathematical abilities. Reference [16] also revealed in their research that through the guided discovery model that is Guided Inquiry Learning assisted by autograph software influences students' mathematical abilities.

Learning is also done by using teaching material that supports LAS which is adjusted to the characteristics and syntax of the learning models of GDL and CTL. Thus with the LAS, students are guided to understand concepts and solve mathematical problems that are given.

5.2. Ability to Understand Students' Mathematical Concepts in the Convergent Learning Style Group is higher than the Divergent Learning Style Group

Learning style is an individual/student way of carrying out activities of thinking, processing, absorbing, or

understanding information more easily. The learning styles of students examined in this study are convergent, divergent, accommodation and assimilation. How students absorb information more easily affects the ability to understand mathematical concepts. The ability to understand mathematical concepts is the ability/competency shown by students in understanding the definitions, understandings, special characteristics, nature, essence/content of a mathematical material and competence in performing procedures (algorithms) in a flexible, accurate, efficient and precise manner.

Based on the calculations, the results show that the average comprehension ability of students' mathematical concepts as a whole with convergent learning style groups is 78.65, for the divergent learning styles group is 67.57. Thus, based on the average value of students' understanding of mathematical concepts the highest is the convergent learning style group. Individuals with this convergent learning style are best at finding practical uses of ideas and theories. He is able to solve problems and make decisions effectively. Prefer to handle problems and technical tasks rather than social and interpersonal issues. In formal learning situations, he tends to experiment with new ideas, simulations, laboratory assignments, and practical applications. These students like to experiment with new ideas according to the Guided Discovery Learning model. And based on calculations, the average value of students' mathematical abilities with convergent learning styles for classes that get Guided Discovery Learning (78.48) is higher than Contextual Teaching and Learning (67.57).

Furthermore, by testing Hypothesis II using two-way ANAVA the results are obtained that there are differences in the ability to understand students' mathematical concepts between convergent and divergent learning styles. To see which learning style is better, then proceed with the t test. Based on the t test assisted with SPSS statistical software 25, it was found that convergent learning styles are better than divergent learning styles. This means that students who tend to experiment with new ideas, simulations, laboratory assignments, and practical (convergent) applications have better concept comprehension skills than students who prefer to work in groups and receive personal feedback, have social interests who is tall and tends to be imaginative, and has a very divergent feeling. Students who like experimentation and are better at solving problems such as converging have better concept understanding skills compared to groups of students with divergent learning styles.Guided Discovery Learning (GDL) is a learning model that develops the way students actively find themselves and investigate for themselves the concepts to be learned. Through this Guided Discovery Learning model, students are taught to use ideas, concepts, and skills they have learned to find new knowledge and increase understanding of an issue, topic or issue with the teacher's knowledge as a facilitator. Through this Guided Discovery learning, the results obtained by students will last long in memory and will not be easily forgotten.

6. Conclusions

Based on the results of research and data processing, the following conclusions can be drawn:

1. The ability to understand mathematical concepts of students taught by Guided Discovery Learning assisted by Autograph Software is higher than students taught by Contextual Teaching and Learning (CTL) assisted by Autograph Software.
2. The ability to understand students' mathematical concepts between convergent learning style groups is higher than that of divergent learning style groups. for table title, table head, and table text are provided. Tables should be set in one column wherever possible and be placed near their first mention in the body. Tables and figures do not need to be placed on separate pages at the back of the manuscript.

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ORIGINALITY REPORT

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SIMILARITY INDEX

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