

# A Comparative Study of Students' Learning Achievement of Sigma Notation Number Sequences and Series Taught Through Discovery and Expository Method

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## ABSTRACT

This study determines the level of student achievement using the discovery method compared with the expository method in teaching the sigma notation of number sequences and series in grade 1 SMA Neg 1 Ajangale. This research is a quantitative research that is an experiment. The population is all students in grade 1, where class 1A is 32 students and class 1B is 30 students. The instrument is a test in the form of an essay. Data analysis techniques are descriptive statistical analysis and inferential statistical analysis. The research results are 1) The level of student achievement using the discovery method in the sigma notation of number sequences and series obtained from 32 students were 93.7% of students classified as Very Low 2) The level of student achievement using the discovery method in the sigma notation of number sequences and series obtained from 30 students were 63,3% of students classified as very low, 3) the results of inferential statistical analysis,  $X_{\text{count}} = 26,04 > X_{2 \text{ table}} = 3,84$ . This means that  $H_0$  is rejected and  $H_1$  is accepted. The achievement of students taught using the discovery method is better than the expository method in teaching the sigma notation of number sequences and series.

**Keywords:** *Learning Achievement, Discovery Method, Expository Method.*

## 1. INTRODUCTION

The rapid development of science and technology today is inseparable from the support of quality human resources. However, to produce quality human resources, it must also be supported by the quality of the education that can be useful for developing the nation and state.

RI Law Number 20 of 2003 concerning the National Education System, article 1 paragraph 1 states that education is a conscious and planned effort to create a learning atmosphere and learning process so that students actively develop their potential to have religious-spiritual strength, self-control, personality intelligence, noble character, and skills needed by the community, nation, and state.

The learning process in educational units is held interactively, inspiring, fun, challenging, motivating students to participate actively, and providing

sufficient space for creative and independent initiatives by students' talents, interests, and physical and psychological development. (Law No. 20 of 2003, National Education System)

Education is not an amateur job but a professional job that cannot be left to anyone. Education develops from the simple (primitive), which occurs when humans are still in the scope of a simple life. The goals are very limited to survival (defense of life against natural threats), to a form of education full of methods. Plans and models are thought of in accordance with today's society [1].

Mathematics is one means of scientific thinking indispensable to developing thinking logically, systematically, and critically. Likewise, mathematics is the basic knowledge needed by students to support their learning success in pursuing higher education. Therefore, students need to have sufficient mathematical knowledge to face the future.

Realizing the importance of mathematics, improving mathematics learning outcomes at every level of education needs serious attention. Mathematics learning outcomes from primary and secondary education levels are still often stated or voiced low or even very low compared to the scores of other lessons. One of the criteria that must be considered is increasing mathematics learning achievement in schools. It is necessary to use mathematics teaching to decide to teach or choose the suitable teaching method according to the subject of the language being conducted.

According to [2], the learning method is used to implement the plans prepared in real or practical activities to achieve learning objectives. Therefore, teachers should choose or combine several appropriate teaching methods, which can affect the success or failure of the mathematics learning process.

The discovery method is one of the teaching methods sought as optimally as possible under the teacher's guidance. Active student involvement in the process of learning mathematics. The discovery method is defined as a teaching procedure that emphasizes teaching, individuals, object manipulation and experimentation, before arriving at generalizations. So the discovery method is a component of educational practice, which includes teaching methods that promote active learning, process-oriented, self-directed, self-seeking, and reflection [3].

The expository learning method places the teacher as the center of teaching because the teacher is more active in providing information as the manager and controller of all learning activities [4]. In general, the teacher conveys the subject matter through lectures hoping that students can understand it and respond according to the material being taught.

The sigma is one of the subjects taught in class 1 semester II, which can be conducted using the expository and discovery methods. The discovery method teaches students to find their way under the teacher's guidance. In contrast, the expository method is a one-way method; the teacher gives ideas/hurries, the students accept them.

Based on the description presented, the author is motivated to examine the use of the discovery method in teaching the sigma notation of number sequences and series.

## **2. THEORETICAL REVIEW**

### ***2.1. Mathematics Learning Achievement***

The term "achievement" in the Indonesian dictionary means the results achieved. So learning achievement is the result achieved by someone after making a learning effort [5]. Regarding students as subjects who make an effort to learn, [6] points out that student achievement is the level of achievement achieved by students after being involved in the educational process for a certain period to find out by using a tool in the form of a learning achievement test.

The achievement or achievement factor is used as a consideration in determining the final value because the achievement or achievement of students, which is symbolized by learning values, basically reflects the extent to which the level of success that students have achieved in achieving the educational goals that have been determined for each subject or field of study.

Student achievement is the level of progress achieved by students with particular learning objectives [10]. The conclusion is that mathematics learning achievement is the result achieved by students after making an effort to learn mathematics within a certain period. These results reflect these students' mastery and understanding of the mathematical material studied within the period.

### ***2.2. The Nature of Mathematics***

*Mathematics* comes from the word *mathema* in Greek, which means science, knowledge, or learning. Also, from the phrase *mathematics*, which means learning tribe. Mathematics is a collection of concepts with a systematic structure, sequence with a clear, logical flow, and a hierarchy between one concept and another, meaning that one concept and another are mutually supportive and related [6]. So, in learning mathematics, it is necessary to know the first one to solve the problem in the next concept.

According to [11], no one has been able to define mathematics perfectly in one sentence. Most of them are incomplete definitions because they are only from a certain point of view. Furthermore, [11] describes some examples of mathematical definitions that experts have made:

- a) Mathematics is the knowledge of numbers and calculations;
- b) Mathematics is the knowledge of logical reasoning and dealing with numbers;

- c) Mathematics is the knowledge of quantitative facts and problems of space and form;
- d) Mathematics is the knowledge of logical structures;
- e) Mathematics is the knowledge of strict rules.

Studying mathematical materials is not enough just to be learned by reading. A theorem, proposition, property, or definition to understand takes time and perseverance. If we need mathematical material, we are often forced to read it repeatedly to know its meaning even though it usually only consists of one sentence. Mathematics Learning Achievement

Learning achievement is students' abilities after they receive their learning experiences [10]. The results of learning events can appear in various types of changes or evidence of a person's behavior.

According to [12] broadly speaking, the factors that influence learning achievement can be divided into three types, namely:

- 1) Internal factors (factors from within students), namely the physical and spiritual state/condition of students;
- 2) External factors (factors from outside students), namely environmental conditions around students;
- 3) The learning approach factor (approach to learning), namely the type of student learning effort, includes the strategies and methods used by students to carry out learning activities of subject matter.

Gagne said that mathematics learning achievement is the abilities that students have after they receive their mathematics learning experience, or it can be said that mathematics learning outcomes are behavioral changes in students, which are observed and measured in the form of changes in knowledge, behavior, attitudes, and skills after studying mathematics [13]. This change is interpreted as an increase and development in a better direction than before.

Mathematics learning achievement measures a student's ability to acquire knowledge about calculations that are usually abstract and obtained based on their efforts. Mathematics learning achievement is obtained by understanding and applying mathematical concepts after participating in the teaching and learning process. A test is used as a measuring tool to measure students' level of success in learning mathematics.

**2.3. Discovery and Expository Method**

Guided discovery is a structured learning method to explain concepts and the relationship between

concepts. A written concept or principle will create directed and systematic learning [14]. While [15] suggests that the discovery method is a translation of discovery, namely a mental process where students are left to find themselves, the teacher only provides guidance and instruction. This makes it easier for teachers and students in the learning process so that learning becomes more meaningful. Several stages in the guided discovery method are the introduction (student orientation in problems), the open stage (organizing students in problems), the convergent stage (presenting/presenting), and the closing stage (evaluating activities and activity results) [14].

The expository learning method, according to [4], is a learning method that emphasizes the process of delivering material verbally from a teacher to a group of students with the intention that students can master the material and lessons optimally. Based on the description above, it can be concluded that the expository learning method is a learning method that conveys the material directly by the teacher to students with the aim that students can master the material optimally. The subject matter delivered by the teacher in the expository learning method is usually a ready-made subject matter, such as data or facts, certain concepts that must be memorized so that they do not require students to repeat themselves.

**2.4. Sigma Notation Material, Number Sequences, and Series**

Sigma notation is a way of writing briefly from the summation form, symbol notation sigma ( $\Sigma$ )  
For example:

$$a_1 + a_2 + a_3 + \dots + a_n = \sum_{i=1}^n a_i$$

**Figure 1.** Symbol notation

The right-hand side of the form is read as "the sum of it for I = 1 to 1 = n". The numbers 1 and n are called the lower and upper limits of addition, respectively. The set (1,2,3,.....n) is called the addition region.

Example:

Express the following quantities in sigma notation.

- a. 1+4+16+25+36+49
- b. 5+7+9+11+13+15+17+19

Answer:

a. 1+4+9+16+25+36+49  
= 1<sup>2</sup>+2<sup>2</sup>+3<sup>2</sup>+4<sup>2</sup>+5<sup>2</sup>+6<sup>2</sup>+7<sup>2</sup>

$$= \sum_{i=1}^7 n^2$$

b. 5+7+9+11+13+15+17+19

$$\begin{aligned}
 &= (2.1+3) + (2.2+3) \\
 &+(2.3+3)+(2.4+3)+(2.5+3)+(2.6+3)+(2. \\
 &7+3) \\
 &+(2.8+3) \\
 &= (2n+3)
 \end{aligned}$$

Karena  $U_1 = a$  dan  $U_n = a + (n-1)b$ , maka

$$\begin{aligned}
 S_n &= \frac{n}{2} [a + a + (n-1)b] \\
 &= \frac{n}{2} [2a + (n-1)b]
 \end{aligned}$$

Jumlah n suku pertama dari deret aritmatika adalah :

$$S_n = \frac{n}{2} (U_1 + U_n) \text{ atau } S_n = \frac{n}{2} [2a + (n-1)b]$$

Contoh :

Carilah jumlah deret :  $1+3+5+7, \dots$  sampai 20 suku.

Jawab :

$A = 1, b = 3-1 = 5-3 = 2$  dan  $n = 20$

$$\begin{aligned}
 S_n &= \frac{n}{2} [2a + (n-1)b] \\
 S_n &= \frac{20}{2} [2.1 + (20-1)2] \\
 S_n &= 10 [2 + 19.2] \\
 S_n &= 10.40 \\
 S_n &= 400
 \end{aligned}$$

Figure 2. Example

The sequence of numbers is the dominant function is the set of natural numbers. The series of numbers 1,4,9,16,25,.....

The series of numbers 12, 22, 32, 42, 52,.....

The U function associated with the sequence is  $U(N) = N^2$ . This formula is usually written  $U_n = N^2$  where  $N(1,2,3, \dots)$   $U_n =$  The nth term formula. Example: find the formula for the nth term of the sequence 3,8,15,24,.....

n	$U_n$
1	$3 = 1^2 + 2.1$
2	$8 = 2^2 + 2.2$
3	$15 = 3^2 + 2.3$
4	$24 = 4^2 + 2.4$
.	.
.	.
n	$n^2 + 2n$ Jadi $U_n = n^2 + 2n$

Figure 3. Symbol notation

A series is the sum of the terms of a sequence. If the sum of n first terms of an arithmetic series is called  $S_n$ . Then  $S_n = U_1 + U_2 + U_3 + \dots + U_{n-2} + U_{n-1} + U_n + \dots$  (i). Or  $S_n = U_1 + (U_1 + 2b) + \dots + (U_n - 2b) + (U_n - b) + U_n + \dots$  (2). If the number of n terms is reversed, then:

$$\begin{aligned}
 2 S_n &= (U_1 + U_n) + (U_1 + U_n) + (U_1 + U_n) + \dots + (U_1 + U_n) + (U_1 + U_n) + (U_1 + U_n) \\
 2 S_n &= n (U_1 + U_n)
 \end{aligned}$$

$$S_n = \frac{n}{2} (U_1 + U_n)$$

Based on the description above regarding the material of sigma notation, research of number sequences and series is carried out using discovery and expository methods. This is expected to make it easier for teachers and students to learn mathematics more meaningful.

### 3. METHOD

This research is quantitative research with an experimental study to examine the causal effect between the independent and dependent variables. This means that researchers must control all variables that affect the outcome unless the independent variable (treatment) has been determined. The research design used in this study is the pretest-posttest control group design. The population in this study were all grade 1 students of SMA Negeri 1 Ajangale, while the research sample consisted of 33 students in class 1A for the experimental class and 30 students for class 1B for the control class. The instrument used to measure student achievement is a test in the form of an essay. The data analysis technique used is a descriptive statistical analysis to describe student learning outcomes and inferential statistical analysis to test hypotheses.

Descriptive statistical analysis was carried out by determining the category of mathematics learning outcomes for grade 1 students at SMA Negeri 1 Ajangale, Bone Regency. The statistical subject in this study was using a Likert scale, namely, very high, high, medium, low, and very low. From the level of mastery above, the criteria for determining achievement in learning mathematics are very low, low, medium, high, very high.

Table 1. Description of Learning Achievement Values Taught Using the Discovery Method

Statistics	Statistical Value
Sample size	32
The highest score	62
Lowest Value	23
Average score	39.7
Standard Deviation	12.04
variance	145.2

While inferential statistical analysis aims to test the research hypothesis, the statistical analysis used is the average difference test or with the following formula:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{S_{\text{gab}}} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

**Figure 4.** Statistical formula

The hypothesis test category is that if t-count > t table at a significant level of 0.5 percent, the proposed research hypothesis is accepted.

## 4. RESEARCH RESULTS AND DISCUSSION

### 4.1. Mathematics Learning Achievement Taught Using the Discovery Method

Characteristics and learning achievement test results of grade 1 students of SMA Negeri 1 Ajangale on sigma notation, number sequences, and series. For each group is presented as follows:

The results of descriptive statistical analysis show that the level of student achievement taught by using the discovery method in the sigma notation of number sequences and series in class 1 SMA Neg 1 Ajangale obtained experimental class about 32 students (93.7%) who have learning achievement classified as Very Low with an average score of 39.7, standard deviations of 12.04, the highest score of 62 and the lowest 23.

### 4.2. Mathematics Learning Achievements Taught Using the Expository Method

The results of descriptive statistical analysis showed that the level of student achievement taught by using the expository method in the notation of sigma sequences of numbers and series in class 1 SMA Neg 1 Ajangale obtained a control class of 30 students (63.3%) get mathematics learning achievement test scores classified as Very Low, with an average score of 51.2, a standard deviation of 11, the highest score 77, and the lowest 31.

**Table 2.** Description of Learning Achievement Values Taught Using the Expository Method

Statistics	Statistical Value
Sample size	30
The highest score	77
Lowest Value	31
Average score	51.2
Standard Deviation	11
Variance	131.3

### 4.3. Comparison of Mathematics Learning Achievement

Based on the results of inferential statistical analysis, after calculating, X2 count = 26.04 and X2 table value = 3.84. From the two X2 above, it appears that the X2 count is greater than the X2 table. This means that Ho is rejected and H1 is accepted, so it can be concluded that the level of achievement of grade 1 students of SMA Negeri 1 Ajangale taught using the discovery method is better than the expository method in teaching the sigma notation of number sequences and series.

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