

PAPER • OPEN ACCESS

Improving place value ability for children with learning disability using *balok pelangi ienes* as Media

To cite this article: E Efrina *et al* 2019 *J. Phys.: Conf. Ser.* **1321** 032007

View the [article online](#) for updates and enhancements.

The image shows a promotional banner for IOP ebooks. On the left, there is a collage of colorful book covers with scientific and technical illustrations. On the right, the text reads: 'IOP | ebooks™' in a bold, sans-serif font. Below this, it says 'Bringing together innovative digital publishing with leading authors from the global scientific community.' and 'Start exploring the collection—download the first chapter of every title for free.' in a smaller font.

IOP | ebooks™

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection—download the first chapter of every title for free.

Improving place value ability for children with learning disability using *balok pelangi ienes* as Media

E Efrina*, Marlina, Y Maulina and Y Helsa

Universitas Negeri Padang, Padang, Indonesia

*Corresponding author: elsaefrina@fip.unp.ac.id

Abstract. The use of *Balok Pelangi Dienes* aims to improve the ability to determine place value for students with learning disability. The ability to determine place value is profoundly needed as prerequisites in the acquisition of other mathematical concepts, such as the operation of addition, subtraction, and others. The type of the research was the experiment using single-subject research approach with A-B-A design. The subject of the research was elementary school student in grade 5 aged 11 years old. The target behavior research was the increase of ability to determine place value through reading and writing numbers. The data of the research were measured using frequency to identify correct answers on condition of A1 (first baseline), B (intervention) and A2 (second baseline). The results showed that the frequency of student's correct answers has significantly increased after the intervention. This was proved by the inclination of increased line direction and the small percentage of overlapping data. Therefore, the use of *Balok Pelangi Dienes* as media can improve the ability to determine place value for students with learning disability.

1. Introduction

Some elementary school students have difficulty in understanding the concept of place value, particularly students with learning disability. Students at the primary level are hardly able to determine the place value [1-7], whereas the concept of place value is profoundly required and influential towards the other math concepts. The concept of place value becomes a prerequisite for arithmetic operations such as addition and subtraction in learning mathematics. When students are unable to determine the place value, they are also practicing errors in naming and writing down multi-digit numbers as well as in operation of addition with carrying technique, subtraction with borrowing technique, column addition and multiplication [1-2, 7-8].

Determining the place value is associated with how a number is written and pronounced. Since the numeral system used in Indonesia is the Hindu- Arabic numerals, it follows the powers of 10 system (base 10) which its digit's place value determined by the position of the digits 0, 1, 2, 3, 4, 5, 6, 7, 8 and 9 with regular names and is tautly related to its meaning [9]. The concept requires an understanding of place value in the integration of the concept of grouping ten with procedural knowledge of how a set is recorded in the scheme of place value, as well as how a number is written and pronounced.

Based on the preliminary studies conducted, the researchers found a student with learning disability whom has difficulty in determining the place value and incorrectly reads and writes numerals. The student wrote 2000023 for 223 and read the numbers into two-two-three or twenty-two -three. The inability of the student to determine the place value resulted in failure to round the numbers into nearest place value. The student made the error when determining numbers into targeted place value



and the other arithmetic operations such as addition, subtraction, multiplication, and division. Some errors made were resulted from the inability to determine the place value. For instance, in addition with carrying, the student was failed to place the number into the correct position when operating with the column addition, such as $46 + 7 = 106$, the student put 'seven' below 'four' instead of 'six'. In another case, the student borrowed and carried at the wrong number and also did not subtract the borrowed number. These findings are similar to those which discussed by [2, 7-8].

The learning of place value is the fundamental lesson that is considered easy, but in fact, many students in the elementary school find it hard to determine the place value because the material in determining the place value is an abstract concept. Hence the teaching process should be based on the learning principle of math concepts, which is starting from the concrete, to semi-concrete and eventually to abstract concepts. The lesson does not begin from the definition, but it begins by observing examples through the media/props [6, 10-11]. It should be noted that the learning medium needs to be prepared in accordance with the characteristics of the students, and the goal is one that must be considered. The media will support the students' understanding of the abstract mathematics; therefore, skills and innovation in developing or creating media learning are necessary especially for students with learning disability [12].

Block *Dienes* is one of the media used in learning place value. Block *Dienes* functions to teach a concept or understanding about many objects, compare and sort the objects, the place value of a number (ones, tens, hundreds, and thousands) as well as the operations of addition, subtraction, multiplication, and appropriate level of division [2, 13-15]. The use of block *Dienes* in learning place value represents the basic knowledge of the powers of ten, the ability of oral representations, and symbolic representations [1, 4]. With those points, *Balok Pelangi Dienes*, modified from Block *Dienes*, is well-fitted to improve the ability to determine the place value which is related to the ability in reading and writing numbers as well as rounding the numbers. Researchers modified the media by leveraging the use of sequential colors on block *Dienes* in instilling the concept of place value. The order of these colors refers to Indonesia children's songs titled "Pelangi" which has been always taught in the kindergarten. The color 'red' stands for the ones, 'yellow' stands for the tens, and 'green' stands for the hundreds. Researchers also used a mini suitcase as storage container equipped with colored boxes functioned to allow the student to organize the blocks and determine the place value as well as a value of zero, and there were also two mini whiteboards placed to write long addition form and numerals.

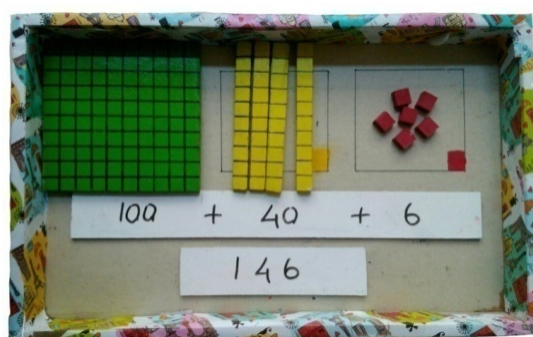


Figure 1. *Balok Pelangi Dienes*

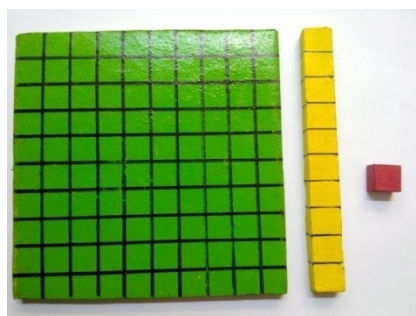


Figure 2.Units of tens, hundreds and thousands



Figure 3. *Balok Pelangi Dienes* outside look

Based on the explanation above, the research discussed the influence of *Balok Pelangi Dienes* as media towards the concept of place value on students with learning disability.

2. Method

This research used a quantitative approach. The type of research conducted was an experiment in the form of single-subject research (SSR), which the research looked at the impact of the frequently given intervention on a single object. This research used A-B-A design where condition (A1) is the object condition before the intervention, condition (B) is the object condition under intervention, and condition (A2) is the object condition after the intervention. Variables in this research consisted of free variable and bound variable. The free variable was the media (*Balok Pelangi Dienes*). *Balok Pelangi Dienes* is a modification of block *Dienes* which the colors sequence taken from Indonesia children song "Pelangi". The blocks are made of log, plastic or paper used to embed the concept of quantity, number, place value, operations of addition, subtraction, multiplication, division and it is the easier way to help the students with learning disability [1, 10, 16]. Meanwhile, the bound variable was the ability to determine the place value in ones, tens and hundreds. The ability to determine the place value is the ability to determine the value of a number/digit in numerals based on the position of the number with the given names such as ones, tens, hundreds, thousands and so on [2, 9, 17-18].

The subject of the research was a girl from grade 5 in elementary school. The data collected through direct observation aimed to observe the student's demeanor and the phenomenon occurs when answering the question about determining the place value. The given test aimed to measure student's ability in determining the place value in the baseline condition (A1), the intervention condition (B) and the second baseline condition (A2). The tools used in collecting the data were written test questions, while the data recordings were conducted by calculating the frequency from the number of correct answers.

3. Results and Discussion

The research was conducted in 24 meetings; 6 meetings in phase A1, 12 meetings in phase B and 6 meetings in phase A2. The findings of the observation are presented as table 1:

Table 1. Records of Frequency of correct answers

Target	Baseline (A1)	Intervention (B)	Baseline (A2)
Results	5, 7, 5, 6, 6, 6	11, 12, 14, 15, 22, 21, 25, 29, 30, 30, 30	30, 27, 28, 28, 28, 28
Mean	5,83	22,33	28,18
Trend	(+)	(+)	(-)
Stability	1,05	4,5	4,5
Range			
Mean level	5,83	22,33	28,18
Upper limit	6,355	24,58	30,41
Lower limit	5,305	20,08	25,91
Stability Percentage	50%	17%	100%

The data ratio of each phase in baseline A1, intervention B and baseline A2 is shown in the figure 4:

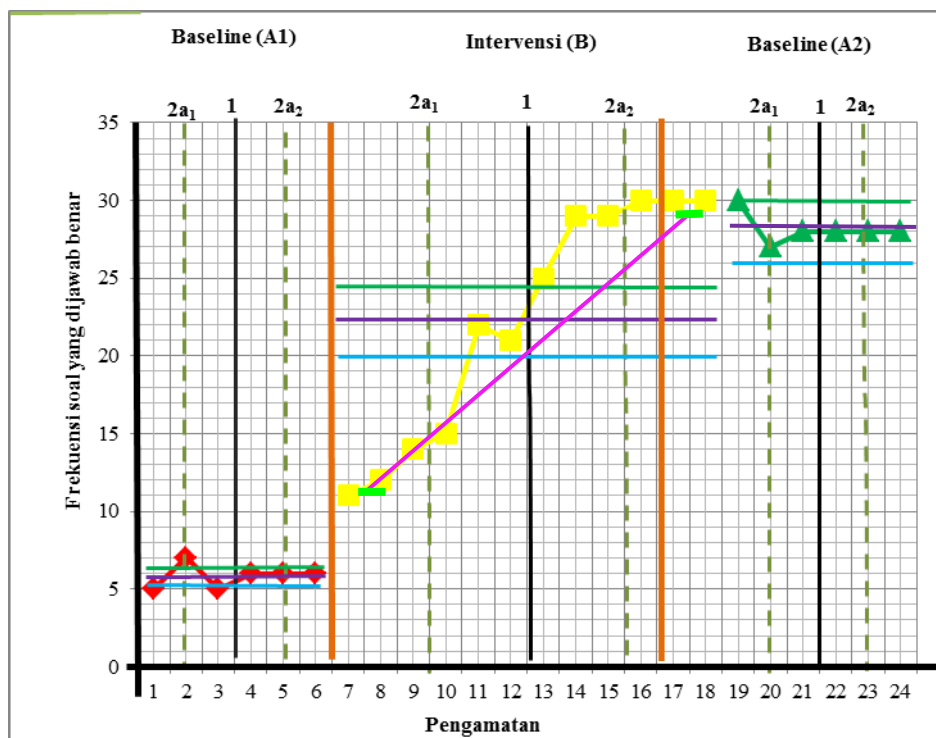








Figure 4. Chart Analysis in conditions

Descriptions:

-  : Frequency of correctly answered questions
-  : Mean level
-  : Trend line
-  : Upper limit line
-  : Lower limit line
-  : Point of intersection *mide date* and *mide rate*

According to the above table and chart, there is an upward trend in baseline phase as the line is ascending, whilst in the intervention phase, the line is still upward but it slightly falls down in the second baseline. The stability trend uses the stability feature of 15%. The direction trend is considered stable when its stability percentage is placed somewhere between 80%-90% [19]. The stability trend of condition A1 obtained was 50% which means the results were unstable or variable. The calculation of the stability trend in condition B was 17% resulted in unstable results or variable. In the contrast, the calculation of stability trend in condition A2 was 100% means the results obtained were stable.

The data trend on condition A1 showed the initial capability of the student viewed from the slight line increment. On condition B, the steep line described the ability of the student which increased after intervention using *Balok Pelangi Dienes*. On condition A2, the student's ability slightly declined due to the student's inadvertence but is still increasing compared to the ability on condition A1. While the range at A1 condition was 5-7, on condition B, the range was 11-30 and on condition A2, the range was 27-30. On the level change of A1 condition, found data differences on the first day and the last day where the student solved five correct problems on the first day and six correct problems on the last day, hence the lane raised and marked with (+). On condition B, the gap between the first day and the last day was 19 with an upward lane, means that the student's demeanor was well improved, hence it was marked with (+) since it provides the purpose of the intervention that is improving the ability to determine the place value. Whilst on condition A2, there was an extremely slight difference, a regression in level change and it was marked with (-).

Based on the analysis of the conditions, the variable to be changed was the ability to determine the place value, and then the number of variables to be converted from baseline condition (A1) to intervention (B) and to baseline (A2) is one. The change of stability trend in the conditions was based on the stability trend in conditions of A1, A2, and B on the analysis of the conditions. Therefore, the change of the stability trend from A1 to A2 is of a variable to the stable.

The overlap between condition A1 and condition B, and condition B and A2 were calculated by means of the data observation on the condition B involved in the range of condition A1 divided by the amount of data observation in condition B and likewise the overlap between condition B and condition A2.

$$\text{Percentage of overlap } B/A_1 = \frac{0}{12} \times 100\% = 0\%$$

$$\text{Percentage of overlap } B/A_2 = \frac{0}{6} \times 100\% = 0\%$$

The above calculation implies that the intervention using the modified *Balok Pelangi Dienes* as media has the influence towards the ability improvement in determining the place value. The summary analysis of inter-conditions in the research is shown in the table 2:

Table 2. Summary of Findings Analysis inter-conditions

Comparison	A ₂ /B/ A ₁ (3:2:1)	
	B/ A ₁	A ₂ /B
1. The amount of variable to change	1	
2. The change of trend and its effect	(+)	(-)

	Positive	
3. The change of stability trend	Variable to stable	
4. The change of level	(11-6) +5	(30-30) 0
5. The percentage of overlap	0%	0%

The findings showed that *Balok Pelangi Dienes* has improved the student's ability to determine the place value and the ability to round the numbers according to their place value. The result of this research was similar to the previous research (such as Muhammad Faisee, 2012) which showed that the block *Dienes* has enhanced the capability to understand the concept of place value for students with mild mental disability. Using *Balok Pelangi Dienes* as media transforms the abstract material becomes the concrete one and helps the students to understand the concept of place value through the shape, size, and colors of the media. Besides, it is not merely functioned to help the student to solve the problems in order to improve the student's ability [2, 13-15, 20-21], as explained that *Balok Pelangi Dienes* also functions to teach the concept or understanding about many things, compare and sort many objects, the place value of a number ones, tens, hundreds, and thousands) as well as the operations of addition, subtraction, multiplication, and appropriate level of division. In addition, researchers assumed that *Balok Pelangi Dienes* can also be used in teaching rounding numbers which is included in the ability to determine the place value. Using *Balok Pelangi Dienes* as media helps the students with learning disability to understand the abstract concept of place value. As stated by Ormond and Steele [22-23] that student with learning disability are experiencing challenges such as difficulty to pay attention against distraction, regression in reading skills, ineffective learning and memory strategies, and the difficulty to complete the abstract reasoning-related tasks.

In order to improve the ability to determine the place value of units in the ones, tens, and hundreds, the researchers used *Balok Pelangi Dienes* by wielding the colors sequence that has been learnt from the kindergarten, to read and write the numerals. The use of color sequence can improve the student's by 30%-40%, give learning satisfaction, evoke the motivation and emotion to learn, and improve the learning outcome [24-26]. The researchers also provided the media with a mini suitcase containing a whiteboard and a box to place units. The mini suitcase functioned as the storage and media usage. The whiteboard on the suitcase aimed to improve the student's memory since the use of the media requires the student in viewing and doing simultaneously. The use of the boxes aimed to affirm the place value of zero hence the student would not be confused with the place value of zeros by looking at the empty box. The use of *Balok Pelangi Dienes* gives an understanding of the concept of place value and improves student's ability to determine the place value and the student's ability in solving problems regarding the place value, as well as implementing the rounding rules. The student is able to determine the number of the targeted place value and understand the concept of roundings, which number greater than or equal to (\geq) 5 (ones) is rounded up into one in tens and number lesser than 5 is rounded up into zero; likewise number greater than or equal to (\geq) 5 (tens) is rounded up into one in hundreds and number lesser than 5 in tens is rounded into zero.

The steps the researchers conducted when implementing the media i.e. preparing a room, media, stationery and ensuring the student's condition. The steps conducted firstly are praying, delivering the learning objectives and conducting the lesson with numerals material. The number of digits formed in the ones, tens, hundreds and thousands in ratio. Secondly, naming the place value and its position of the numerals based on the way it is read and written. Then, the student was introduced to the media (*Balok Pelangi Dienes*); its size, colors and the number of the block in each unit representing its place value. The student began to compose a long addition and decompose the result through the column addition technique. Further, the student determined the place value of the digit by observing the color and size of *Balok Pelangi Dienes* and determined the value of the number. Finally, the student compared two numbers and rounded the number using the media.

The student's initial ability to determine the place value was below the standard and it required treatment to improve the student's ability. During the intervention using *Balok Pelangi Dienes* as media, the student's ability has significantly improved. The frequency of correctly solved questions was slightly down for a while due to the student's inadvertence but has been recovered and increased in the next stage. The student's decline after a given intervention is not because a misguided concept but due to her inadvertence in solving the problems. This can be seen from her tendency to write excess zeros than she should and fail to copy the answer from the scratch paper. Besides, the student tended to rely on her memory about the answer on previous meetings, so she often mistakenly wrote the answer to the question with almost similar numbers. But when the student was given the intervention using *Balok Pelangi Dienes*, the student's ability to determine the place value was resulted above standard and has significantly increased compared to her initial ability.

4. Conclusions

Based on the data analysis on conditions and data analysis inter-conditions, the research found that intervention using *Balok Pelangi Dienes* as media is influential towards the ability to determine the place value and rounding the numbers for students with learning disability. This was proved by the increase of student's ability in solving the problems about determining the place value. In addition, the calculation of overlap percentage between data A1 and B was insignificantly 0% and the overlap percentage of data B and A2 was also 0%.

5. Acknowledgments

Thanks to all the teams involved in writing this article and thank you for the enthusiasm and cooperation of the research subjects.

References

- [1] Berman J 2011 SToPV A Five Minute Assessment of Place Value. Australian Primary Mathematics Classroom 16(4) pp 24–28.
- [2] Chan W W L, Au T K, and Tang J 2014 Strategic Counting: A Novel Assessment of Place-Value Understanding. Learning and Instruction 29 pp 78–94
- [3] Moeller K, Pixner S, Zuber J, Kaufmann L, and Nuerk H C 2011 Early Place-Value Understanding as a Precursor for Later Arithmetic Performance-A Longitudinal Study on Numerical Development. Research in Developmental Disabilities 32(5) pp 1837–1851.
- [4] Novembris S 2012 Meningkatkan Pemahaman Konsep Nilai Tempat Bilangan Melalui Media Blok Dienes pada Anak Tunagrahita Ringan (Padang: Universitas Negeri Padang)
- [5] Purwasih R, Damri, and Armaini 2014 Jurnal Ilmiah Pendidikan Khusus 3 pp 354–364
- [6] Selvianiresa D 2017 Jurnal Pendidikan Dasar II pp 65–73
- [7] Yusri A Y and Sari M 2017 Mosharafa 6(1) pp 141–152
- [8] Zelin Z A, Efrina E, and Zulmiyetri 2013 Jurnal Ilmiah Pendidikan Khusus 4(3) pp 678–688
- [9] Purnomo and Wahyu Y 2014 Bilangan Cacah dan Bulat (Bandung: Alfabeta)
- [10] Kurumeh M S, Chiawa M A, and Ibrahim M O 2010 Res. J. Math. Stat. 2(3) pp 101–104
- [11] Maulana, Djuanda D, Hanifah N, Gusrayani D, Aeni A N, Julia, Jayadinata A K, Irawati R, and Panjaitan R L 2015 Ragam Model Pembelajaran di Sekolah Dasar (Sumedang: UPI Sumedang Press)
- [12] Ariani Y, Helsa Y, Ahmad S, and Prahmana R C I 2018 J. Phys.: Conf. Ser. 943(1)
- [13] Al-Baity S A Z, Margiati, Kresnadi H 2015 Jurnal Pendidikan dan Pembelajaran, 4(1)
- [14] Scheer J K 1985 Child. Educ. 62(2) pp 115–121.
- [15] Yulastri 2017 Jurnal Penelitian Pendidikan Indonesia 3(2) pp 57–66.
- [16] Sukayanti and Suharjana A 2009 Pemanfaatan Alat Peraga Matematika dalam Pembelajaran di SD (Yogyakarta: Pusat Pengembangan dan Pemberdayaan Pendidik dan Tenaga Kependidikan (PPPPTK) Matematika)
- [17] Gunarsa and Singgih D 2014 Dari Anak Sampai Usia Lanjut (Jakarta: PT BPK Gunung Mulia)

- [18] Santoso B, Tumijan, and Purwanto 2005 *Pintar Matematika untuk Sekolah Dasar Kelas 4* (Jakarta: Grasindo)
- [19] Sunanto J, Takeuchi K, and Nakata H 2006 *Penelitian dengan subjek tunggal* (Bandung: UPI Pres)
- [20] Jayanti S D 2014 *Pengaruh Penggunaan Alat Peraga Block Dienes terhadap Hasil Belajar Matematika Siswa pada Pokok Bahasan Perkalian dan Pembagian*. Skripsi (Jakarta: UIN Syarif Hidayatullah)
- [21] Lestari M 2015 *Jurnal Ilmiah Pendidikan Khusus* 4(3) pp 534–541.
- [22] Ormond J E 2008 *Psikologi Pendidikan Membantu Siswa Tumbuh dan Berkembang* (Jakarta: Erlangga)
- [23] Steele M M (2005). *Curr. Issues Educ.* 8(10)
- [24] Priyasudiarja Y and Purwaningsih Y S 2014 *Pintar Bahasa Inggris dengan Mind Map* (Jakarta: Kawahmedia)
- [25] Sugiarto I 2011 *Mengoptimalkan Daya Kerja Otak dengan Holistik dan Kreatif* (Jakarta: Gramedia)
- [26] Yaumi M and Hum M 2018 *Media dan Teknologi Pembelajaran* (Jakarta: Prenandamedia Group)