

## Developing Number Puzzle Learning Media for Elementary School Dyslexic Students: Single Subject Research

Sumarno Ismail<sup>1\*</sup>, Nursiya Bito<sup>2</sup>, Franky Alfrits Oroh<sup>3</sup>, Nisky Imansyah Yahya<sup>4</sup>,  
Fuji Sandra Talibo<sup>5</sup>

<sup>1,2,3,4,5</sup>Mathematics Education Department, State University of Gorontalo, Indonesia

\*Email: [sumarnoismail@ung.ac.id](mailto:sumarnoismail@ung.ac.id)

---

Received: 22 February 2023; Revised: 14 April 2023; Accepted: 5 September 2023

---

**Abstract.** A child displaying symptoms of dyslexic learning disorders requires assistance in accurately identifying numbers, particularly those that share resemblances. This research aimed to develop media for teaching dyslexic children to help them identify numbers correctly. This research employed a development and single-subject research method. The subject was a child with symptoms of dyslexia learning disorders from primary school in Gorontalo, Indonesia. The research instruments used were observation sheets and media validation. The findings revealed that prior to engaging with the puzzle activity, the dyslexic student demonstrated the capability to identify a range of 4 to 5 numbers accurately. However, after participating in the puzzle activity, the dyslexic student exhibited an improved performance, achieving the ability to correctly recognize and recall 8 to 10 digits in both writing and memory. The number puzzle media was developed by dividing the puzzle into two parts: the part of the screen containing the complete picture and the base placing the puzzle pieces. The puzzle pieces were made by stacking several formed duplex parts, then covered with paper glued together to create a waterproof product. The puzzle focused on the numbers contrasting in color. The numbers were divided into several parts to make it easier for dyslexic students to identify models of these numbers. After conducting media testing on a dyslexic student, the analysis demonstrated a positive impact of the media on learning outcomes. This research suggests a notable improvement in the numerical identification skills of the dyslexic student.

**Keywords:** dyslexia, media, puzzle, numbers

---

**How to cite:** Ismail, S., Bito, N., Oroh, F.A., Yahya, N.I., Talibo, F.Z. (2023). Developing Number Puzzle Learning Media for Elementary School Dyslexic Students: Single Subject Research. *Jurnal Didaktik Matematika*, 10(2), 170-186. DOI: <https://doi.org/10.24815/jdm.v10i2.30955>

---

## Introduction

Stipulated within Indonesian Law No.39, article 60 about human rights is the assertion that each child is entitled to receive education and instruction within individual development, aligned with their interests, talents, and level of intelligence. This articulation underscores that every child is entitled to an appropriate education irrespective of their circumstances. The scope of education encompassed in this context encompasses diverse subjects, including mathematics. Learning mathematics is essential because mathematics and daily activities are inseparable (Usman, Yahya, Bito, & Takaendengan, 2022). Moreover, mathematics serves as a valuable tool guiding individual in making rational decisions throughout their life journey. It shows that complex mathematics plays a role in improving the ability to think logically. In addition to the ability to think logically, mastering the most basic mathematical concepts also requires children

to develop complex logical processes, such as analysis, synthesis, generalization, and comparison at a high level (Khamidova, 2022). These abilities also affect children with learning disabilities. Suhartono (2016) delineated nine distinct categories of learning disorders as follows: (1) visually impaired or blind children, (2) children with hearing impairment or deafness, (3) children with quadriplegia or limb/movement disorders, (4) gifted children exhibiting exceptional abilities and intelligence, (5) children with intellectual disabilities, (6) children classified as slow learners, (7) children with communication disorders, (8) children with emotional and behavioral disorders, and (9) children with specific learning disorders such as dysgraphia, dyscalculia, and dyslexia.

Dyslexia is a learning disorder that can be identified in school-age children. It falls under the category of specific learning disability (SPLD) and primarily manifests as difficulties in reading. Among various learning disorders, dyslexia is the most prevalent and extensively studied. This neurological and lifelong condition is hereditary, affecting approximately one in ten individuals. Consequently, around 20% of individuals experience challenges in reading and writing due to dyslexia (Adamu & Soykan, 2019).

Researchers have no agreement regarding a universally agreed definition of dyslexia and consensus on the exact cause (Kundi & Alharbi, 2022). The prevalence rate of dyslexia varies depending on how dyslexia is defined (Knight, 2018). However, previous studies have tried to define dyslexia. Aljojo, Munshi, and Almukadi (2018) stated that dyslexic children and adults suffer from neurological problems, causing their brains to process and interpret data unexpectedly. Yunus and Ahmad (2022) stated that dyslexia comes from the Greek word "dys," which means difficulty, and "lexis," which means terms. So, dyslexia is a condition in which students experience problems with reading and processing information in the brain. The cause of the hampered reading ability for dyslexic students is their weakness in identifying letters. Specifically for learning mathematics, it is difficult for them to remember numbers.

In order to facilitate students in number identification, enhancing the quality of education becomes imperative. Learning media serves as a means to streamline teachers' efforts in attaining the desired learning outcomes. When these media effectively convey information, educators benefit greatly. To realize the intended learning standards, teachers must exhibit innovation and creative thinking to devise appropriate mediums to facilitate teaching and learning.

An ideal teacher can adeptly manage the learning process, including motivational skills, creativity, and an ongoing dedication to innovatively provide learning materials and media for their students (Suseno, Ismail, & Ismail, 2020). The primary objective of effective teaching management is to enhance individual knowledge competence, enabling educators to convey

information proficiently to their students (Huda, Anshari, Almunawar, Shahrill, Tan, Jaidin, & Masri, 2016). In this pursuit, teachers should draw from diverse tools and blend them with varying pedagogical approaches, encompassing a comprehensive spectrum of potential learning strategies (Bagila, Kok, Zhumabaeva, Suleiminova, Riskulbekova, & Uaidullakzy, 2019). One practical approach for enhancing students' comprehension of subject matter involves employing media as a learning tool. As the sources of learning extend beyond the teacher's input, the role of educators has evolved, leaning more towards that of facilitators (Tahir, Ismail, Oroh, Zakaria, & Usman, 2022).

The quality of learning can improve with tools. Tools designed in such a way as to facilitate the learning process are also learning media (Bito & Mount, 2021). Its function is to assist during the teaching process, one of which is to support the teaching methods used by the teacher. So, the media will help the techniques and concepts of learning in the classroom. So, to improve the quality of learning and students' understanding of numbers, a number puzzle media was developed as a learning tool for dyslexic students.

The puzzle was chosen as a suitable media for dyslexic students. Puzzles in learning will create a less tense understanding atmosphere because students learn while playing (Wungguli & Yahya, 2020). Mathematics teachers should present exciting lessons without creating a frightening impression. So, puzzles, as teaching media, in the classroom can utilize as motor skills, creativity skills, memory improvement, and fun playing tools for students.

The puzzle function generally acts as a medium to improve memory and involve fine motor skills. Relevant to the physical condition or symptoms of dyslexic students who quickly forget or have difficulty concentrating on learning. Puzzle also serves to overcome one of the symptoms of dyslexia, which is slow writing because the number of models adjusts to the basic models. That is why puzzles number are considered the right solution as a suitable medium for this case.

To provide appropriate and influential puzzles for dyslexic students, this research is development research and media trials with single subject research (observations related to whether or not media influences objects). Both of these methods consider relevant to be the answer to the problems raised. This research focuses on producing a learning product/visual aid for students with dyslexia. It is expected that the development of teaching aids will help dyslexic students learn mathematics. The teaching aids, or media designed for dyslexic students, are intended for the topic of numbers because it should be mastered before studying mathematics further at the next level. If students have difficulty identifying numbers alone, continuously operating numbers will overwhelm them. Therefore, this puzzle teaching aid/media expects to help dyslexic students learn numbers.

The teacher provides props and equipment of various types for learning (Zhu, Wang, Cai, & Engels, 2013). The teaching aids help students understand mathematics (Ordu, 2021). Also, visual aids enable students to use their listening or seeing abilities and actively do something while learning. Generally, visual aids can assist teachers in facilitating a better understanding of the subject matter, preventing confusion (Alshatri, Wakil, Jamal, & Bakhtyar, 2019). Teaching aids are essential and cannot be separate from the learning context.

The visual aids referred to in this study are the puzzle media comprising numbers 1 to 10. This selection was based on the observation that dyslexic students often struggled to recognize these specific numerals accurately. They frequently encountered confusion, such as mistaking the number 6 for a backward-written 9 or confusing the number 3. The challenges dyslexic students faced in identifying these numbers motivated the researchers to design puzzle media featuring preliminary number fragments. The intention behind creating these fragmented number pieces is to foster the development of students' fine motor skills, enabling them to construct puzzles that reflect the actual shapes of the numbers. This step precedes shaping the numbers using pencil strokes on paper. By incorporating these number puzzles, dyslexic students' memory retention for numbers can be stimulated, leading to a noticeable enhancement in their ability to identify numbers compared to their previous performance. Due to their intricate nature, puzzles deepen both students' creativity and memory capacities, as highlighted by Marta (2017).

Several previous studies regarding learning for dyslexic students using puzzle media have been conducted, such as Pratiwi, Hapsari, and Argo (2015) and Aljojo et al. (2018), which utilize puzzles as educational games for dyslexic students. Their findings showed that the students were motivated to learn to read and experienced increased learning ability and memory. However, a distinction emerges between the current research and the studies above. While the prior research delved into and supplemented students' reading proficiencies, this study takes a distinct focus by concentrating on the identification of numbers through the medium of learning puzzles. Unlike the prior investigations, which predominantly centered on reinforcing reading skills, the novelty of this research lies in its emphasis on fostering fundamental numerical aptitude. Currently, scant attention has been directed towards developing puzzles aimed at stimulating rudimentary mathematical skills related to numbers among dyslexic students. Thus, considering the need and the lack of literature that raises dyslexic students and puzzles explicitly made to identify numbers, the researchers-initiated research in media development as a solution to overcome this problem. Thus, the study aims to answer this research question: How to develop number puzzle media for dyslexic students, and does the monthly puzzle media affect dyslexic students?

## Method

This study employed research and development with single-subject research method, A-B design. Single-subject research is research specifically for exceptional children with special needs (Widodo, Kustantini, Kuncoro, & Alghadari, 2021). The goal is to find the relationship between variables. This research also considered experimental research with good internal validity. The research was conducted from September to October 2022. The location for the study was one Islamic primary school in Gorontalo, Indonesia. The subject is a student with dyslexia. She was the only student at the school with dyslexia because the school was not a specific school for children with learning disabilities.

The subject of this study is a girl born into an amiable family environment, yet she has developed feelings of insecurity and shyness as she grows up. Additionally, her sister is a child with special needs. The presence of dyslexic learning disorder was detected by multiple assistant psychologists within the school setting. The researchers were informed of this information through the school principal, who served then. To acquire supplementary information, the researchers also collaborated with a psychology graduate to gather data relevant to her diagnosis. These data were collected and analyzed using the following techniques:

- a. Data collection techniques are (1) *observation sheet*, the observation sheet was used to collect data related to the results of the information on whether the student experiences physical symptoms as a dyslexic student. In addition, the observation sheet was used to observe students' readability trials of the media. (2) *Media validation sheet*, sheet validation media was used to collect data on whether or not the developed puzzle media was valid. The validation sheet contains questions for the experts to assess. The psychologists involved were lecturers, psychology students, and teachers. (3) *Interview of practicality media*, media interviews were conducted with teachers at school to be used as a reference for the practicality of the media. The contents of the interview were related to the practicality of the media, such as whether the media was easy to use for students and teachers. (4) *Test media for media effectiveness*, the media trial aimed to collect data on student changes in identifying numbers before and after using the number puzzle media. The trial results were then listed in a table containing the number of treatments, the time of implementation, and the scores obtained from each treatment.
- b. Data analysis techniques are (1) *Analysis of observation results*, observation sheet analysis, for both what happened in identifying dyslexic students and those used as observations of the readability test in this study, were calculated using a Likert scale. (2) *Media validation sheet analysis*, the media validation sheet, the final result of the

validator's assessment, was analyzed quantitatively using a Likert scale. (3) *Interview analysis*, the results of interviews with teachers regarding the practicality of the media was analyzed qualitatively. (4) *Media testing analysis*, at the media trial stage, the data were analyzed using single-subject research. The analysis was carried out visually through a graphic interpretation, providing an overview related to the increasing effectiveness of the media before and after use.

## Results and Discussion

The following are the steps for the development method and the single-subject research used in the study.

### 1. Define

#### *Front-end Analysis*

In this front-end analysis stage, the researchers set the initial and final expectations of the research. The initial hope was that the number puzzle media could be developed for dyslexic students. Ultimately, the media will help students identify numbers.

#### *Learner Analysis*

In this stage, the researchers analyzed the form of observing students regarding the problem in their learning and what researchers can do to solve. The researchers included an identification sheet of the dyslexic student's symptoms addressed to teachers who intensively work with these students. In addition, the researchers also held discussions with teachers and parents about the difficulties the student encountered in learning. Researchers were also directly involved in observing the student with dyslexia. Based on the results of these observations, the student fell within the classification of individuals frequently manifesting symptoms indicative of dyslexia. This information was also supported by the testimony of the teachers, who stated that they had also received a visit from a psychologist who applied some treatment to the student. The results showed that the student was dyslexic.

#### *Concept Analysis*

In this section, we analyze the needs of a dyslexic student. The researcher analyzed with several psychology alum experts, and the goal was to formulate appropriate media for learning these dyslexic students. One of the researcher's tasks is to develop media to stimulate students' writing skills because students with learning disorders, dyslexia, also have symptoms of slow writing. In addition, the press developed must also be adapted to the learning for dyslexic students whose learning style is kinesthetic.

### *Task Analysis*

In the task analysis, the researcher lists the points the researcher will prepare and provide based on discussions with several psychology alums. One of them is an identification sheet to observe the physical symptoms of students with learning disabilities. The identification sheet provides information regarding how often students experience symptoms of dyslexia.

### *Specifying Instructional Objectives*

At this stage, the researchers formulated the learning objectives through the lesson plan. This lesson was then be used in the media trial stage. The lesson plan was adjusted to the competencies achieved in the 2013 curriculum.

## *2. Design*

### *Media Selection*

Puzzle media was chosen as a medium considered suitable for students with dyslexia due to the ability related to puzzles aligning with the physical symptoms suffered by those with dyslexia. Puzzle games can help dyslexic students, who are slow to write and remember/manage information, by improving fine motor skills and developing memory. The role of the mystery used with the kinesthetic learning style fits the category of students with dyslexia whose must be directly involved in learning.

### *Format Selection*

At this stage, the researcher brought the puzzle media before the psychologist alums to identify several formats that have been considered. Some suggestions regarding the puzzle format are pieces of numbers that should not be too small, the color of the numbers in the puzzle should be more contrasting, and student's interest in the characters chosen in the mystery. These format suggestions are collected to be then realized in a learning media.

### *Initial Design*

The researchers designed the media at this stage by learning number puzzles through software. This media was created using several characters suiting the children's age, like the Upin and Ipin characters in (Figure 2). The objects of learning were numbers, so the load of numbers in the initial design must be considered. Figure 1 displays the initial design of the number puzzle media for students with learning disabilities. The number puzzle media, an instructional aid, was meticulously crafted using readily available tools and materials. Beyond their accessibility, the chosen tools and materials are cost-effective and eco-friendly. Moreover, the quantity of puzzle pieces has been tailored to align with the comprehension level of dyslexic students. For instance, the numeral 8 is disassembled into two circles, while the figures 6 and 9 are presented as a sequence and a line. This distinctive characteristic sets dyslexic number

puzzles apart from their conventional counterparts. Unlike the prevalent whole-number puzzle pieces, the developed puzzle media is designed as a visual support for dyslexic students.



Figure 1. Initial design number puzzle media

### 3. Develop

At this stage, the researchers developed several puzzle media for students with learning disabilities. The development was carried out as made in the initial design, using the following steps.

#### *Media Production*

At this stage, the researchers provided the necessary tools and materials. Next, they created the media based on the draft concept. The following are the steps for making number puzzle media.

#### *Providing Tools and Materials*

The tools and materials needed in the development of number puzzle media were as follows: 5 duplexes, 2 pieces of Styrofoam, 2 pieces of white cardboard, 1 piece of Fox glue size 150-gram, 1 pair of scissors, 1 cutter and its contents, and 11 sheets of A4 size paper.

#### *How to make puzzle media*

The puzzle media can be made using the following steps: (1) Preparing tools and materials. (2) Printing the puzzle image (to get the complete image into several HVS sheets, image printing can be done via Microsoft Excel). (3) Laminating the printout of the image, so that the media is waterproof. (4) Cutting the laminating results into several shapes, especially for numbers, cut them into some basic patterns. The primary ways in question are: 0 is divided into 4 parts, with each half of the circle divided by 2. Number 1 does not need to be divided. Number 2 is divided between the semicircle and the horizontal line. Number 3 is split in the middle becoming two semicircles, and number 4 is divided into three parts by a horizontal line. Number 5 is divided into a semicircle and two horizontal lines. Number 6 is divided into a circle and a curved line, as with Number 9. Number 7 is divided into two parts, namely two horizontal lines, and finally, number 8 is divided into two parts, namely two circles. The pattern image on the duplex corresponds to the paper model that has been laminated. (5) Cutting the duplex

according to the pattern made and sticking it on the template on the laminated paper (use 3 to 4 layers of the duplex to get enough thickness for children to grip). (6) Preparing the name/writing of the puzzle's name, serving as the identity of the mystery. (7) The puzzle is ready to use once all puzzle attributes are completed.

#### 4. Expert Appraisal

When the puzzle was done, it was validated by experts. Validation was carried out for one lecturer from the psychology study program, one Master's degree student in Psychology, and a teacher who conducted the research data analysis on media validation using the Likert test. The Likert test showed that the media was suitable for dyslexia students.

The feasibility/quality of the product based on the validator's assessment was measured using a Likert scale value. The Likert scale was chosen because it is relevant to interpret media feasibility. Table 1 presents the media feasibility percentage categories based on the Likert scale.

Table 1. Product feasibility/quality category based on likert scale

| No | Percentage                 | Category        |
|----|----------------------------|-----------------|
| 1  | $0\% \geq X \leq 19.99\%$  | Not feasible    |
| 2  | $20\% \geq X \leq 39.99\%$ | Poorly feasible |
| 3  | $40\% \geq X \leq 59.99\%$ | Fairly feasible |
| 4  | $60\% \geq X \leq 79.99\%$ | Feasible        |
| 5  | $80\% \geq X \leq 100\%$   | Very feasible   |

Source: (Rahardja, Lutfiani, & Rahmawati, 2018)

#### 5. Media Revision

During the validation with the experts, several revisions were required in the development of number puzzle media. The first revision is a revision of the initial design of the software. The validator recommended that the initial design be adjusted to the interests of dyslexic students. So, the initial plan must be communicated with the student's homeroom teacher. After speaking with the homeroom teacher, it turned out that dyslexic students liked pink characters, so the media designs were changed the characters Masha and the Bear (Figure 2).



Figure 2. Puzzle design before (left) and after (right) revision

Modifications were also introduced to the number puzzle learning media alongside the revised design, transforming it into puzzle pieces. Keeping the number of puzzle pieces minimal

is advised to prevent overwhelming complexity for the students. Given that learners with learning disabilities often become disinterested swiftly, an excess of puzzle pieces could lead to frustration, potentially hindering their willingness to persist with the learning process. Consequently, the puzzle pieces, initially featuring various Upin and Ipin characters, were refined to depict Masha and the Bear's karate theme (as illustrated in Figure 3).



Figure 3. Puzzle before (left) and after (right) revision

The next step was marking the puzzle screen to make it easier for students to identify the puzzle shapes to be paired. The puzzle screen must be equipped with piece markings so that students have no difficulty determining the positions of each piece. In addition, some attributes, such as operation symbols, were omitted because the operating marks are unnecessary to introduce numeric material (Figure 4).



Figure 4. Puzzle before (left) and after (right) revision

## 6. Readability Test

After the last revision, the researchers continued with the readability test. It was conducted to determine whether students could understand the concept of number puzzle media. The readability test was carried out by the teacher observing students with eautistic symptoms. The observations showed that the number puzzle media was 96% (readable). In addition, students with autistic symptoms, who at first just lay down in class during the learning process, when asked to play puzzles, immediately changed their mimics to become excited and even successfully assembled puzzle pieces enthusiastically.

### 7. Media Trials with Single Subject-research AB (Baseline-intervention) Design

The readability test was followed by a media trial using the single-subject research method, the A-B design, for students with dyslexia. In this method, the dyslexic student was observed whether she experienced changes before using the media (baseline) and after using the media (intervention). Table 2 provides the data on the number puzzle media trial for the dyslexic student.

Table 2. Data from media trials using the single-subject research method

| Phase        | Treatment               | Score |
|--------------|-------------------------|-------|
| Baseline     | I (15 September 2022)   | 4     |
|              | II (26 September 2022)  | 4     |
|              | III (28 September 2022) | 5     |
| Intervention | I (29 September 2022)   | 8     |
|              | II (30 September 2022)  | 8     |
|              | III (3 October 2022)    | 10    |
|              | IV (4 October 2022)     | 8     |
|              | V (October 4, 2022)     | 8     |

The data in Table 2 displays information about the number of numbers identified by the student. In the first and third treatments, the student could only identify 4 to 5 correct numbers before using the media. Furthermore, in the first and fifth treatments, the student can correctly specify 8 to 10 numbers after using the puzzle. The above data were analyzed in each condition, namely the conditions in the phase of not using the mystery (Baseline) and after using the secret (Intervention). The data were then analyzed between basic needs to intervention conditions. This analysis provides an overview of the improvements/changes and the influence obtained by the student before and after using the number puzzle media. Furthermore, the data can also be illustrated in Figure 5.

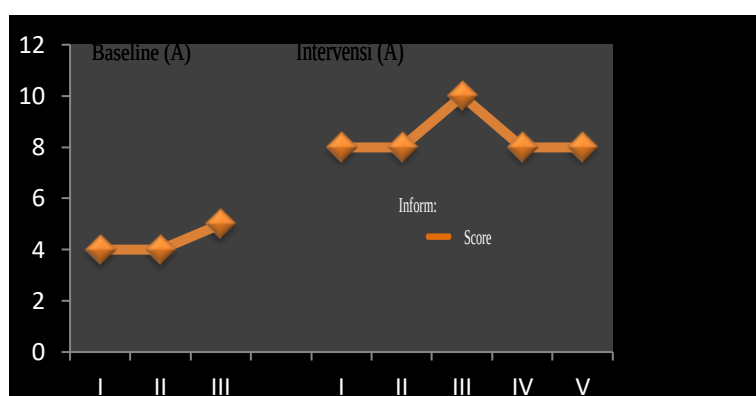


Figure 5. Graph of number puzzle media test results

Figure 5 clearly shows the differences before and after using the media. Before using the media, the student can only identify 4-5 correct numbers. Meanwhile, she used the media, the numbers identified were 8-10. Table 3 presents the data analysis results in conditions and between conditions of the single subject research.

Table 3. Component analysis data in conditions

| Phase        | Analysis          | Score |
|--------------|-------------------|-------|
| Baseline     | Condition length  | 3     |
|              | Directional trend |       |
|              | Stability range   | 0.75  |
|              | Mean levels       | 4.33  |
|              | Upper limit       | 4.075 |
|              | Lower limit       | 3.58  |
| Intervention | Condition length  | 5     |
|              | Directional trend |       |
|              | Stability range   | 1     |
|              | Mean levels       | 8.4   |
|              | Upper limit       | 8.9   |
|              | Lower limit       | 7.9   |

Table 3 provides information about the length condition (the number of numerical identification test treatments for the dyslexic student) in each phase. Where the student passed the test three times before using the media and five times after using the media. In addition, a split middle image shows the increasing ability of the dyslexic student. Besides, Table 3 displays the mean, upper limit, and lower limit values to determine the data's stability. These values are interpreted through Figure 6, later analyzed between conditions to provide information regarding data stability in each state and the proportion of overlapping values as a reference to show the importance of media effectiveness.

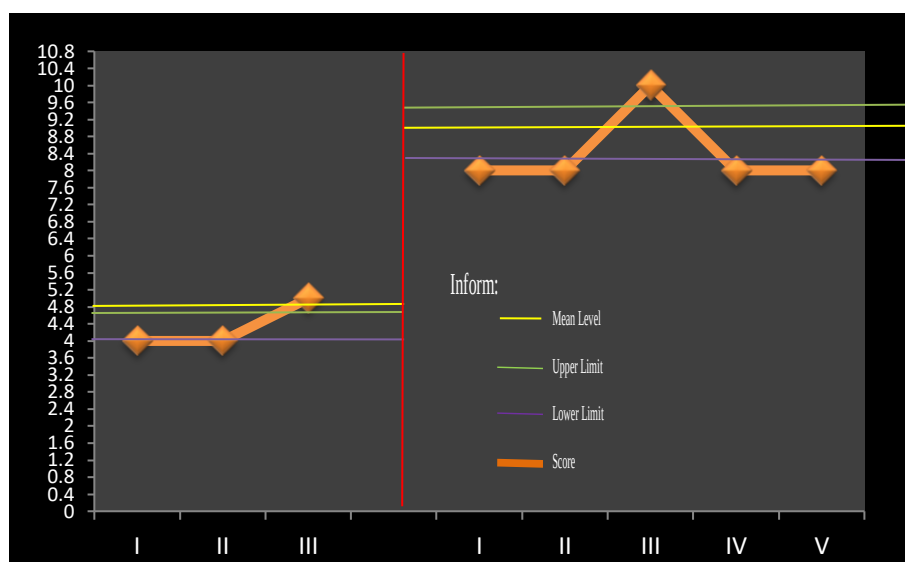


Figure 6. Graph of mean, upper limit, and lower limit values

The mean, upper limit, lower limit values on Figure 6 provide information that the baseline phase point data was in the range of the upper limit (green color) and lower limit (purple color), namely 2 (66.67% or unstable data). Meanwhile in the intervention phase, there is 1 data point in the range of the upper limit (green color) and 4 points of the lower limit

(purple color) (80% or stable data). This means that before the students played the puzzle, the numbers identified by students showed no stability or fluctuating. However, after interacting with the puzzle, student's ability increased. In 4 trials, the student succeeded in identifying 8 numbers, and in one trial, students were able to identify 10 numbers correctly. Figure 6 also shows that the baseline and intervention phases are different as the student experienced an increase in the correct numbers from 4-5 to 8-10. This finding agrees with (Prahmana, 2021) who found that students' number recognition ability improved when learning using puzzle (Prahmana, 2021). Table 4 presents the summary of the components in the analysis between conditions obtained from Figure 5.

Table 4. Component analysis data between conditions

| No. | Analysis                    | Score              |
|-----|-----------------------------|--------------------|
| 1.  | Variable number             | 1                  |
| 2.  | Change of direction trend   | Good               |
| 3.  | Changes in stability trends | Unstable to stable |
| 4.  | Level change                | Increase           |
| 5.  | Overlapping percentage      | 0 %                |

Table 4 shows that 1 variable changed. At the same time, the changes occurred were good (the numbers identified by students were increased). Meanwhile, data before and after media usage changed from unstable to stable, as interpreted in Figure 6. The level of student's abilities was also enhanced after using the puzzle. Furthermore, the proportion of overlapping data was 0% (smallest percentage), meaning that the puzzle has a great influence of the students in identifying numbers. The smaller the value of the overlapping proportion, the more influential the media is on behavior (Prahmana, 2021).

The achievement of the puzzle in enhancing the knowledge of dyslexic students marks this research as having a potential impact within the education sector. It catalyzes transforming educators' perspectives, underscoring that students with special needs or learning disabilities are equally capable of grasping mathematics just like their peers without disabilities. Educators are responsible for imparting knowledge to all students, not solely those considered typical. Furthermore, this research extends to insights for advancing puzzle development. For instance, modifications could involve tactile adaptations or auditory cues for puzzles catering to visually impaired students, supporting their learning of concepts such as fractions, squares, and beyond.

#### 8. Disseminate

Disseminate is the final stage of developing the puzzle media. At this stage, the researchers conveyed all information related to the media through discussion programs conducted with school teachers. The information shared included the method of making, the materials needed, and the benefits and functions of the number puzzle media.

Once all the research processes were done and the data was collected, this study found that the puzzle can be developed and positively influence dyslexic students. The effect of a good puzzle is relevant to finding of Aljojo et al. (2018), reporting in their research that 100 percent of respondents strongly agreed that the puzzle improve dyslexic students' abilities and 100 percent agreed that puzzle can improve the memory of dyslexic students.

Relevant opinions regarding the effect of puzzles on dyslexic students were also expressed by Nobakht, Mirmahdi, and Heidari (2020) that puzzles affect working memory and visual perception of space in students with specific learning disorders (reading, writing, mathematics). The puzzle pieces are part of a project that seeks to solve follow-up therapy for children with dyslexia (Jaramillo-alcázar, Venegas, Criollo-c, & Lujan-Mora, 2021). Even in India, learning patterns and letter shapes requiring two to three weeks can be shortened to one week using puzzles (Bose & Jyotsana, 2019). Puzzles accelerate dyslexic students' learning (Salam, John, & Varghese, 2020). The ability to use the right brain makes dyslexic students tend to enjoy puzzles (Burton, 2018).

The ability of puzzles to improve memory for dyslexic students makes it easier for them to identify numbers. Puzzles function as a bridge to remember or improve memory for dyslexic children (Agustin, Seftia, & Widiyanti, 2022). Puzzles are chosen to train the memory of dyslexic children (Purnomo, 2023). Assembling puzzle pieces can improve memory (Claudia, Sujawaty, & Dunggio, 2020). Puzzles are also referred to as a way to stimulate the development of children with dyslexia (Oktamarina, Rosalina, Utami, Duati, Dzakiyyah, Sari, & Julita, 2022).

## Conclusion

The number puzzle media is divided into two main components: a screen section containing the complete image and a foundation intended for puzzle piece placement. Puzzle pieces are made by assembling multiple segments and subsequently enveloping them with adhesive-bonded paper to ensure waterproofing. The focal point of this puzzle centers on contrasting colored numbers. These numbers are then further partitioned into segments, facilitating a more accessible means for dyslexic students to discern the numeric patterns.

The validity of the number puzzle media is confirmed through a quantitative approach involving expert validation. Simultaneously, its practicality is confirmed through a qualitative approach and media interviews. Following the assessment of the media on dyslexic students via single-subject research, its efficacy is evident, as it has been found to wield a positive impact on the learning process of dyslexic students.

This beneficial influence is evident in the enhanced abilities of dyslexic students. Before engaging with the puzzle (baseline phase), students could correctly identify only 3-4 numbers. After utilizing the puzzle as an intervention, their competence surged, with the successful identification of 8-10 numbers—highlighting the efficacy of the puzzle media.

## References

- Adamu, I., & Soykan, E. (2019). Content analyses on the use of technology in dyslexia: The articles in the web of science data base. *International Pnline Journal of Education and Teaching (IOJET)*, 6(4), 789-797. <http://iojet.org?index.php/IOJET/article/view/670>.
- Agustin, I., Seftia, I., & Widiyanti, R. (2022). Analisis penggunaan media spelling puzzle untuk meningkatkan kemampuan membaca permulaan siswa disleksia di sekolah dasar penyelenggara pendidikan inklusi. *Media Penelitian Pendidikan: Jurnal Penelitian dalam Bidang Pendidikan dan Pengajaran*, 16(1), 88–96. doi: 10.26877/mpp.v16i1.12102
- Aljojo, N., Munshi, A., & Almukadi, W. (2018). Arabic alphabetic puzzle game using eye tracking and chatbot for dyslexia. *International Journal of Interactive Mobile Technologies*, 12(5):58–80. doi: 10.3991/ijim.v12i5.8957.
- Alshatri, S. H. H., Wakil, K., Jamal, K., & Bakhtyar. 2019. Teaching aids effectiveness in learning mathematics. *International Journal of Educational Research Review*, 4(3), 448–53. doi: 10.24331/ijere.573949.
- Bagila, S., Kok, A., Zhumabaeva, A., Suleiminova, Z., Riskulbekova, A., & Uaidullakzy, E. (2019). Teaching primary school pupils through audio visual means. *Ijet*, 14(22), 122–40. doi:10.3991/ijet.v14i22.11760
- Bito, N., & Mount, N. F. (2021). *Pengembangan multimedia interaktif bangun ruang di MTs negeri 2 boalemo provinsi gorontalo*. Seminar nasional matematika dan pendidikan matematika (6<sup>th</sup> senatik) program studi pendidikan matematika FPMIPATI-Universitas PGRI Semarang 2021.
- Bose, A., & Jyotsana. (2019). *Design of a digital application to aid hindi alphabet recognition/formation for children with learning disability*. The Asian Conference on Education 2019 of Official conference Proceedings in The International Academic Forum.
- Burton, K. (2018). How dyslexia affects our students. *Williams Honors College, Honors Research Projects*, 612, 1-39.
- Claudia, J. G., Sujawaty, S., & Dunggio, M. (2020). Penurunan disleksia pada balita melalui permainan puzzle alfabeth dan kartu huruf. *Journal Midwifery Jurusan Kebidanan Politeknik Kesehatan Gorontalo*, 6(1), 33-42. <https://doi.org/10.52365/jm.v6i1.315>
- Huda, M., Anshari, M., Almunawar, M. N., Shahrill, M., Tan, A., Jaidin, J. H., & Masri, M. (2016). Innovative teaching in higher education: The big data approach. *Tojet: Turkish Online Journal of Educational Technology*, 1210–1216.
- Jaramillo-alcázar, A., Venegas, E., Criollo-c, S., & Lujan-Mora, S., (2021). An approach to accessible serious games for people with dyslexia. *Sustainability*, 13(20507), 1–17
- Khamidova, M. (2022). Development of speech of mentally mental children in the process of mathematics lessons. *European International Journal of Multidisciplinary Research and Management Studies*, 02(09), 1-4. doi:10.55640/eijmrms-02-09-01 2022.

- Knight, C. (2018). What is dyslexia? An exploration of the relationship between teachers' understandings of dyslexia and their training experiences. *Dyslexia*, 24(3), 207-219. doi: 10.1002/dys.1593.
- Kundi, G. M., & Alharbi, M. F. (2022). Relationship between dyslexia and the academic performance: Mediating role of teacher's awareness. *Revista Amazonia Investiga*, 11(50), 215–31. doi: 10.34069/ai/2022.50.02.21.
- Marta, R. (2017). Penanganan kognitif down syndrome melalui metode puzzle pada anak usia dini. *Jurnal Obsesi: Jurnal Pendidikan Anak Usia Dini*, 1(1), 32-41. doi: 10.31004/obsesi.v1i1.29.
- Nobakht, F., Mirmahdi, R., & Heidari, H. (2020). Effect of computer games (puzzle game and simulation game) in working memory and space visual perception in student with specific learning disorder (reading, writing, math). *Archives of Pharmacy Practice*, 11(S1), 55–59.
- Oktamarina, L., Rosalina, E., Utami, L. S., Duati, S. F. K., Dzakiyyah, C., Sari, R. P., & Julita, M. S. (2022). Gangguan gejala disleksia pada anak usia dini. *Jurnal Multidisipliner Bharasumba*, 1(01), 100-115.
- Ordu, U. B. A. (2021). The role of teaching and learning aids/methods in a changing world. *Bulgarian Comparative Education Society*, 19, 210–216.
- Prahmana, R. C. I. (2021). Single subject research (teori dan implementasinya: Suatu pengantar). *Journal of Chemical Information and Modeling*, 53(9), 1-189.
- Pratiwi, I., Hapsari, F. D., & Argo, C. B. (2015). *Pembelajaran teknik puzzle huruf untuk meningkatkan kemampuan membaca anak disleksia*. Proseding Seminar Nasional PGSD UPY dengan Tema Strategi Mengatasi Kesulitan Belajar ketika Murid Anda seorang Disleksia, 139–146.
- Purnomo, A. (2023). Pengembangan game belajar huruf hijaiyah untuk disleksia dengan metode waterfall. *Jurikom (Jurnal Riset Komputer)*, 10(1), 68-75. doi: 10.30865/jurikom.v10i1.5545.
- Rahardja, U., Lutfiani, N., & Rahmawati, R. (2018). APTISI student perception to the news on the APTISI website. *J. Ilm. SISFOTENIKA*, 8(2), 117–27.
- Salam, R., John, S., & Varghese, S. (2020). Study on mobile learning applications for dyslexia and autism. *International Research Journal of Engineering and Technology (IRJT)*, 07 (02), 1274–1276.
- Suhartono, S. (2016). Pembelajaran menulis untuk anak disgrafia di sekolah dasar. *Transformatika: Jurnal Bahasa, Sastra, dan Pengajarannya*, 12(1), 107–19.
- Suseno, P. U., Ismail, Y., & Ismail, S. (2020). Pengembangan media pembelajaran matematika video interaktif berbasis multimedia. *Jambura Journal of Mathematics Education*, 1(2), 59–74. doi: 10.34312/jmathedu.v1i2.7272.
- Tahir, N. N., Ismail, S., Oroh, F. A., Zakaria, P., & Usman, K. (2022). Analisis kemampuan pemahaman konsep matematika ditinjau dari penggunaan multimedia game petualangan dalam limas berbasis mobile learning Di SMP Negeri 1 Tilango. *Euler : Jurnal Ilmiah Matematika, Sains Dan Teknologi*, 10(1), 15–25. doi: 10.34312/euler.v10i1.12936.
- Undang-undang RI. no. 39, Hak Asasi Manusia.
- Usman, P., Yahya, L., Bito, N., & Takaendengan, B. R. (2022). Efektivitas pembelajaran matematika menggunakan multimedia pada materi kerucut. *Jambura Journal of Mathematics Education*, 3(2), 100–106. doi: 10.34312/jmathedu.v3i2.10628.

- Widodo, S. A., Kustantini, K., Kuncoro, K. S., & Alghadari, F. (2021). Single subject research: Alternatif penelitian pendidikan matematika di masa new normal. *Journal of Instructional Mathematics*, 2(2), 78–89. doi: 10.37640/jim.v2i2.1040.
- Wungguli, D., & Yahya, L. (2020). Pengaruh penggunaan media berbasis information communication technology (ICT) Terhadap hasil belajar siswa pada materi dimensi tiga. *Jambura Journal of Mathematics Education*, 1(1), 41-47. <http://ejurnal.ung.ac.id/index.php/jmathedu>.
- Yunus, H. B., & Ahmad, N.A.B. (2022). Understanding the definition and characteristics of dyslexia. *Malaysian Journal of Social Sciences and Humanities (MJSSH)*, 7(5), 1-9. doi: 10.47405/mjssh.v7i5.1353.
- Zhu, C., Wang, D., Cai, Y., & Engels, N. (2013). What core competencies are related to teachers' innovative teaching?. *Asia-Pacific Journal of Teacher Education*, 41(1), 9–27. doi: 10.1080/1359866X.2012.753984.