Jurnal Fundadikdas (Fundamental Pendidikan Dasar)
Vol. 6, No. 3, November 2023, pp. 212-221
ISSN 2614-1620
http://journal2.uad.ac.id/index.php/fundadikdas

Development and evaluation of culture-based digital sandpaper letters as an effective learning medium for slow learner students in recognizing and writing letters

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Received: September 15, 2023 *Revised: October 11, 2023* *Accepted: November 24, 2024*

KEYWORDS
Slow learners
Digital sandpaper letters
Inclusive education
Culture-based learning
Letter recognition

ABSTRACT

This study addresses the educational challenges faced by slow learner students, who exhibit lower cognitive abilities than their peers, particularly in the context of reading difficulties during elementary school. Recognizing the need for targeted interventions, this research focuses on the development of a culture-based digital sandpaper letter learning medium tailored to enhance the letter recognition and writing skills of slow learner students. The research employs a 4D development model, encompassing define, design, development, and dissemination phases. The sandpaper letters, featuring rough textures, serve as a sensory-motor stimulus to facilitate the learning process for slow learner students. Culturally relevant themes from Indonesia, such as dances, songs, musical instruments, names of weapons, tribes, food, and place names, are incorporated into the design to enhance engagement and connection with the material. Expert assessment sheets and teacher response questionnaires are utilized as assessment instruments. Results indicate that the developed learning medium is validated by experts and deemed practical by teachers. Furthermore, research trials demonstrate the effectiveness of the culture-based digital sandpaper letters in facilitating letter recognition and writing skills among slow learner students. This innovative approach not only addresses the specific needs of this student population but also contributes to the broader field of inclusive education.

Introduction

One of the most basic aspects of the right to education is that every child, without exception, has the right to receive a quality education. Children with special needs are included in this education guarantee. Children with special needs are educated in special schools in Indonesia. However, Special Schools continue to constitute a barrier between children with special needs and children in general, impeding interaction. As a result, special needs children are isolated

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from social relationships in society. As a result, the Indonesian government creates an inclusive education system that allows students with special needs to attend regular schools (Kementerian Pendidikan Nasional Republik Indonesia, 2009). This serves as a deliberate effort to encourage community acceptance of children with special needs. An educational and social environment that enables all children to receive services that are specifically suited to their needs is known as inclusive education (Yusuf *et al*., 2017). A slow learner is one kind of special needs youngster who is permitted to go to regular schools. Children with exceptional difficulties who frequently attend schools yet are hard to spot are these slow learners (Rasmitadila *et al*., 2021). Slow learners had higher IQs than mentally retarded kids, but their scores are still significantly below those of typical kids their age.

Six primary schools in Yogyakarta, one of the first cities in Indonesia to introduce inclusive education, have 64.02% of its kids who are slow learners. These schools are participating in a pilot program to offer inclusive education. According to Mumpuniarti *et al*.'s study, Yogyakarta students who are slow learners experience learning challenges or obstacles. Reading, writing, and counting all suffer from learning issues (Mumpuniarti *et al*., 2020). The learning environment at school is undoubtedly impacted by the significant population of slow learners in conventional schools. This is thus because slow learners tend to have learning styles that are concentrated on skills that must be applied in practice using all the senses and organized using experience as a concrete mediation of symbolic things (Chauhan, 2011). This serves as the foundation for their educational requirements, which must be adapted to the demands of slow learners in public primary schools who need a lot of presentations during the learning process. As a result, as tangible learning material, teachers need to use media or teaching aids.

The findings of Mumpuniarti et al.'s study indicate that slow learners encounter difficulties in both writing and reading (Mumpuniarti *et al*., 2020). Some students still face challenges in reading and writing, exhibiting behaviors such as reading upside down, reluctance to engage in writing, and a complete inability to read or write. It is imperative that all students, including those who may study at a slower pace, acquire the ability to read. This proficiency is essential to facilitate learning across all subjects through reading (Chapman & Tunmer, 2003). The first phase of language acquisition is beginning reading, which is taught in lower grades (Sukma, 2017). The mechanical encoding process of reading, namely the recoding-decoding process, is emphasized when students begin reading in lower grades (Chandra *et al*., 2018). Students identify sound symbols and their combinations with the sounds through the recoding and decoding process. Through this procedure, the texts he reads are converted into a succession of linguistic sounds in intelligible sentences, word groups, and word combinations. Physically and mentally, reading is a process. a physical action that takes the form of reading writing

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aloud. Students can distinguish between distinct sound symbols and their combinations using their visual sense (Taufina & Chandra, 2017).

In comparison to kids their age, slow learners do worse on tests of focus, memory, and abstract thought (Albert, 2018). For this reason, children who struggle with abstract concepts or subject matter need more hands-on instruction. Students who are slow learners may find it challenging to learn if they are provided material in paper and pencil form; they need to be stimulated through a variety of activities (Najma *et al*., 2012). This study served as the foundation for the project, which intends to create digital sandpaper letters based on culture to enhance reading and writing abilities. The research being conducted is unique in that this teaching tool combines the cultural background of Indonesia in addition to paper with written letters like sandpaper, which is already used in the field. This letter made of sandpaper also has a QR code, which, when scanned with a smartphone, will show the letters being studied as well as Indonesian cultural terms whose first letters begin with the letters studied on the letter.

Method

This study adopts a developmental research approach, employing Thiagarajan and Semmel's 4-D mode (Thiagarajan *et al*., 1974). This model encompasses four key developmental stages: define, design, develop, and distribute. The defining stage involves initial-finish analysis, student analysis, curriculum analysis, idea analysis, and learning target specification. Subsequently, the design stage progresses with activities such as media selection, format selection, and the initial design of sandpaper letters. The development step concludes with expert validation, testing, and necessary modifications. In this research, the data collection instruments include an expert assessment sheet with 15 statement items for measuring validity and a student response sheet with 20 statement items for evaluating practicality. The collected data undergoes descriptive processing. Utilizing an adapted five-point scale, score conversion is implemented to assess validity, practicability, and effectiveness (Goebel *et al*., 2009). Table 1 shows the conversion of scores to a five-point scale. A book is deemed valid when assessment results meet at least the criteria for goodness, while practicality is asserted when the responses of both students and teachers align with at least the criteria for goodness. The stage of dissemination involves the distribution and implementation of sandpaper letters to elementary school teachers and slow learners.

Table.1 Classification

Score Intervals	***Criteria***
$X > (\bar{x}_i + 1{,}5\ SD_i)$	Very High
$(\bar{x}_i + SD_i) < X \leq (\bar{x}_i + 1{,}5\ SD_i)$	High
$(\bar{x}_i - 0{,}5SD_i) < X \leq (\bar{x}_i + SD_i)$	Medium
$(\bar{x}_i - 1{,}5SD_i) < X \leq (\bar{x}_i - 0{,}5SD_i)$	Low
$X \leq (\bar{x}_i - 1{,}5SD_i)$	Very Low

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Results and Discussion

Slow learners in regular classes are a phenomenon that is often found in public and private schools. In Indonesia, slow learner students who join regular schools are provided with inclusive education services. The term slow learner is given to students who have scholastic thinking abilities, but tend to have below average abilities (Peltopuro *et al*., 2014). The research results show that slow learner students have difficulties in writing and reading (Mursalin, 2021). Reading is a basic skill that all students must have, including slow learners. The large number of slow learner students in regular schools certainly has an impact on the learning process at school. This is because the learning characteristics of slow learners are focused on learning abilities that must be carried out in practice involving all the senses, and using concrete objects. Therefore, sandpaper letters were developed to help slow learner students learn to recognize and write letters.

Book development starts from the Define stage. The Define stage begins with front-end analysis. The analysis begins with Minister of National Education Regulation No. 41 of 2007 concerning Process Standards for Primary and Secondary Education units. The Minister of National Education Regulation states that the learning process must be carried out in an interactive, inspiring, fun, challenging and motivating way for students to participate actively, as well as providing sufficient space for initiative, creativity and independence in accordance with students' talents, interests and physical and psychological development. The next analysis examines books related to the characteristics of slow learners. Learning is more effective for slow learner students if they use concrete media or images (Sugapriya G & Ramachandran C, 2011). Learning will be maximized if slow learner students use all their senses (Najma *et al*., 2012). Next, interviews were conducted with teachers regarding the needs of slow learner students. The findings from interviews conducted with multiple elementary school teachers in Yogyakarta revealed certain information; specifically, teachers encountered challenges in acquiring tangible resources for teaching reading and writing letters. These interview outcomes align with research conducted by Duke, which asserts that teachers confront difficulties in identifying suitable media and materials to aid students with slow learning abilities (Duke & Block, 2012).

After the front-end analysis is carried out, the learner analysis is then carried out. Learner analysis is carried out by examining student learning achievements in reading and writing skills. Next, concept analysis is carried out to identify and organize the material that will be developed on sandpaper. Sandpaper letters are a medium used to introduce letters to children in a concrete way. The sandpaper letter that will be developed is thick paper that contains embossed letters. The letters feel rough when touched. The aim of this fingering activity is to

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provide activities for students to recognize letters concretely before learning to read and write. Students learn to recognize letters by looking and touching, as well as listening to each letter as it is pronounced. The student will feel the letters with his fingers, tracing the outer edges in the same direction as he will write them later. This touching activity is in accordance with Montessori's theory "The hands are the instruments of man's intelligence" which means the hands are a tool or means for obtaining human intelligence (Motessori, 2013). The activity of touching or tracing letters and numbers will stimulate students' fine motor skills (Pittelli, 1965).

The Design Stage starts from selecting the media and format for the sandpaper. Sandpaper was developed using 150-gram art paper with dimensions of 21cm x 21cm. Next, initial design is carried out by making a sandpaper content plan. The plan drawn up is sandpaper using the theme of daily activities, and the letters on the sandpaper are printed embossed and rough. The concept of embossed and rough letters is adopted from sandpaper letters in Montessori classes. The purpose of embossed and rough letters is so that students can touch and feel the shape of the letters. This activity of touching or tracing letters will stimulate students' fine motor skills (Lillard, 2021). The novelty of the research being developed is that it is not just paper containing written letters such as Montessori sandpaper letters, sandpaper letters which were developed using the Indonesian cultural context. This sandpaper letter is equipped with a QR code so that when scanned using a smartphone it will display the letters being studied as well as reading about Indonesian culture. An example of the initial sandpaper letter design that was developed is presented in Fig. 1.

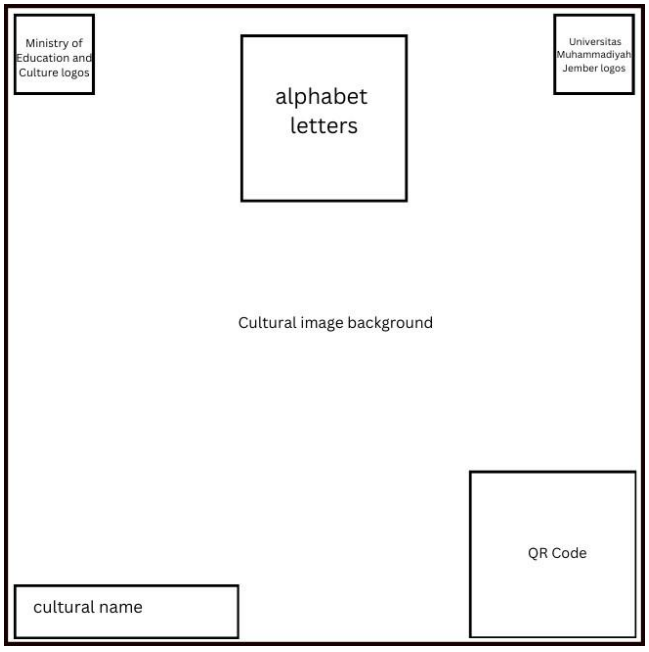

Fig. 1. Cultural sandpaper letter layout design

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The QR code on the sandpaper will be linked to the PDF file. The PDF file contains an explanation of material about the culture contained in the sandpaper. The material layout design is presented in Fig. 2. Next, the sandpaper content plan is developed into sandpaper which is referred to as draft 1.

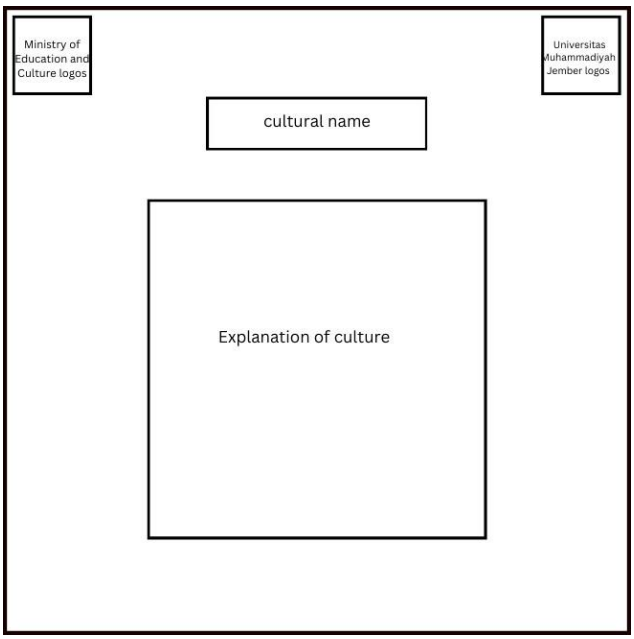

Fig. 2. Layout design

The Development Stage includes expert assessment and limited trials. Expert assessment was carried out on draft 1 which had been developed at the design stage. The results of the assessment by 3 experts are presented in Table 2.

Table.2 Assessment Results Score

Validator	***Average***	***Criteria***
I	82	Very high
II	80	High
III	81	Very high
Average total score	81	Very high

The results of the expert assessment in Table 2 show an average score of 81. Based on Table 1, the average score of the expert assessment results shows that the sandpaper developed has very good criteria. These results indicate that the sandpaper developed is declared valid or suitable for use for trials. Apart from the assessment scores, experts also provide input for improvements to the sandpaper being developed. Input from experts included adding an independent campus logo, improving the layout, adding images to cultural materials, and adding a cover. Sandpaper revisions based on input from experts are presented in Table 3.

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Table.3 Sandpaper revisions

Revised the layout and added the kampus merdeka logo	
Before	***After***
	
Revisions add images to cultural materials	
Before	***After***
	
Adding cover on cultural material PDF files	
Before	***After***
No cover	

Draft 1 which has been revised is called draft 2. Draft 2 is given to the teacher for practicality testing. The results of teacher responses obtained an average score of 82.7. Based on the conversion of Table 1, the average score is in the Very Good criteria, or can be said to meet the practical criteria for use. Apart from providing assessment responses, teachers also provide input on adding letter tracing lines to guide students' writing. The revised image from teacher input is presented in Table 4. Table 4 shows the changes that occurred after being given input by the teacher. This input is adding letter tracing. Letter tracing functions to guide students in writing letters. The final stage is Disseminate. After Draft 2 was revised and declared valid and practical, it was then disseminated on a wider scale. Distribution is carried out by registering cultural sandpaper letters as Intellectual Property Rights and increasing the number of sandpaper letters for use in inclusive schools. Recognizing letters is one of the basic abilities that students must have. Letters are abstract symbols for students, including slow

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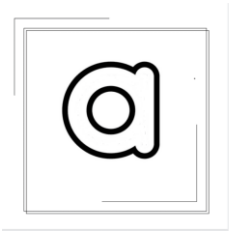
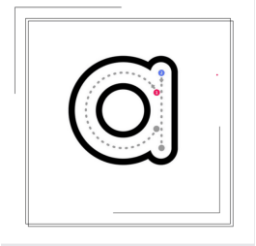
learners. The research results show that slow learner students have difficulty understanding symbols, distinguishing letters and numbers, and distinguishing upper- and lower-case letters (Hirawatillah *et al*., 2023). Slow learner students' obstacles are caused by various factors, one of which is brain development that is not yet optimal due to lack of stimulus (Mohammad & Mahmoud, 2014). Therefore, to introduce letters you cannot just memorize them. Slow learner students need media to learn to read (Puspitasari *et al*., 2021).

Table.4 Add tracing lines

Before	***After***
	

The cultural letter sandpaper developed aims to introduce letters to students. Students will learn to recognize numbers through the activity of touching and feeling the shapes of letters. This activity stimulates students' sensory-motor skills. Research shows that fine motor skills have a positive effect on academic performance, especially in the early years of school (Dolgova *et al*., 2017). Not only that, but students also get to know letters through culture in pictures. This is to attract the attention of slow learner students who have low focus. The presence of pictures is more interesting for slow learner students. The presence of images in the media will improve students' memory and understanding abilities (Raiyn, 2016). The images in the sandpaper letters represent culture which includes regional languages, musical instruments, songs, weapons, place names and artifacts. This culture may not be known to students. This will certainly make students curious about this culture. This curiosity is one of the things that can increase students' interest in learning to read (Dasaradhi *et al*., 2016).

Conclusion

The research results show that the cultural sandpaper letter assessment from experts is in very good criteria. The average score of teacher responses to the criteria is very good. Therefore, the sandpaper letters developed are declared valid and practical for use in learning to recognize and write letters. The tactile letters in sandpaper are expected to stimulate students' sensory-motor skills. It is hoped that the culture in sandpaper can increase students' interest in reading. The trials carried out are still on a limited scale; further research can be carried out in field trials to see the effectiveness of sandpaper letters in learning to recognize and write numbers. Testing the effectiveness of sandpaper can be combined with various learning methods. One method that can be used is the Montessori method.

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