

Developing and Grouping Icon-Based Letter Cues for Bahasa Melayu Learners with Dyslexia: A Formative Classroom Study

Mohd Shahril Iqbal Bin Othman*, Wan Muna Ruzanna binti
Wan Mohamad, Syar Meeze Bin Mohd Rashid

Faculty of Education, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia

*Corresponding Author Email: shahril.iqbal91@gmail.com

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Abstract

Letter learning is a foundational component of early reading and may require additional instructional support for learners with dyslexia. This study reports the formative development and grouping of icon-based letter cues for BACAdys Jilid 1, a structured Bahasa Melayu reading module. The present analysis included seven learners 7-10 years with formally identified dyslexia who completed an individual classroom-based visual recognition activity. Candidate cues were developed using familiar objects, actions, sounds or meaningful visual associations and, where appropriate, incorporated characteristics of the corresponding letter form. Each cue was presented individually and learners were asked, "Ini gambar apa?" ("What is this picture of?"). Recognition was classified descriptively as very fast, fast, moderate or slow while alternative naming, hesitation, incorrect identification and prompting were documented separately. Classroom recordings were reviewed to support the observation records. Findings showed that some cues were consistently recognised and named while others were understood at the semantic level but elicited broader labels or naming uncertainty. These patterns, together with cue-design considerations, informed the organisation of corresponding consonants into progressive instructional groups before formal letter and sound teaching. The study proposes a recognition-before-instruction approach and presents formative design evidence rather than evidence of intervention effectiveness.

Keywords: Bahasa Melayu, Dyslexia, Icon-Based Cues, Letter Recognition, Instructional Grouping

Introduction

Letter knowledge is a fundamental component of early reading development. Before learners can decode syllables and words, they need to recognise individual graphemes and establish increasingly stable relationships between written letters and their corresponding sounds. For learners with dyslexia, developing and automatically retrieving these relationships may require more explicit teaching, systematic progression and repeated reinforcement than for typically developing readers (Snowling et al., 2020; Hall et al., 2023). Contemporary intervention research continues to support structured instruction in foundational reading

skills, including systematic phonics and multisensory reinforcement for learners with or at risk for dyslexia (Hall et al., 2023; de Oliveira et al., 2026).

Although phonological processing difficulties remain central to developmental dyslexia, reading also requires learners to attend to and discriminate visual representations of written symbols. Some learners with dyslexia experience difficulties involving visual attention and orthographic processing, particularly when written information is crowded or difficult to discriminate (Lobier et al., 2014; Gori & Facoetti, 2015). This does not imply that dyslexia is primarily a visual disorder. Rather, it highlights the importance of considering visual presentation alongside explicit phonological instruction. Dyslexia-friendly design research has similarly emphasised learner involvement during the development and evaluation of instructional supports. Abdul Aziz et al. (2022) highlighted the importance of dyslexia-responsive design characteristics while Lorusso et al. (2024) demonstrated substantial individual variation in preferred visual and auditory presentation parameters among children with dyslexia. Together, these findings support a formative approach in which instructional materials are examined in relation to learners' actual responses rather than assumed to function uniformly.

These considerations are particularly relevant to Bahasa Melayu, the national language of Malaysia and the main medium of instruction in national schools. Bahasa Melayu has a relatively transparent alphabetic orthography with generally consistent grapheme-phoneme correspondences. Nevertheless, orthographic transparency does not eliminate reading difficulties. Lee and Wheldall (2011) identified weaknesses in grapheme-phoneme knowledge and phonological skills among low-progress early readers of Bahasa Melayu while Lee (2021) further demonstrated the contribution of phonological processing to Malay literacy acquisition. Systematic attention to foundational literacy skills therefore remains important even within a relatively transparent writing system.

Visual and multisensory supports may provide additional assistance during this foundational stage. Malaysian research has demonstrated the potential value of multisensory approaches for alphabet recognition and mastery among learners with dyslexia (Majzub et al., 2012). One related approach involves pictorial or visual mnemonics, in which an abstract letter is connected with a familiar and meaningful representation. Ehri et al. (1984) demonstrated that pictorial mnemonics were particularly useful when the image and target letter were meaningfully integrated while Shmidman and Ehri (2010) subsequently showed that letters embedded within familiar pictures could facilitate letter learning and reduce confusion compared with less integrated picture-letter associations.

Much of this work has focused on how visual or multisensory supports function during instruction or on their contribution to letter learning and related literacy outcomes (Ehri et al., 1984; Shmidman & Ehri, 2010; Majzub et al., 2012; Hall et al., 2023). More recent dyslexia-friendly design research has extended attention towards accessibility, learner preferences and user involvement during the development of educational supports (Abdul Aziz et al., 2022; Lorusso et al., 2024). However, an earlier formative issue remains important: before a visual representation is used as an instructional cue, it must first be sufficiently recognisable to the learner and its intended meaning should be reasonably accessible. Visual familiarity alone may not be sufficient because an image can be correctly understood at the semantic

level while eliciting a broader everyday term, a familiar synonym or a label from another language. Two characteristics were therefore important during the formative development of the present materials: visual recognisability and naming consistency. Visual recognisability concerns how readily learners identify the represented concept while naming consistency concerns how consistently the intended verbal label is produced.

This issue is especially relevant in Malaysia's multilingual context. Visual mnemonics developed for English or another language cannot necessarily be transferred directly to Bahasa Melayu because the same object may have a different lexical label and initial sound across languages. Learners may also spontaneously retrieve Bahasa Melayu or English labels for the same representation. Consequently, the development of visual cues for Bahasa Melayu requires attention not only to visual familiarity but also to the vocabulary naturally elicited by the representation.

These considerations informed the development of BACAdys, a structured Bahasa Melayu reading module for learners with dyslexia. BACAdys follows a progressive sequence beginning with foundational letter recognition before moving towards letter-sound learning, open syllables, closed syllables and more complex Bahasa Melayu reading patterns. Jilid 1 focuses on foundational vowel and consonant learning and incorporates visual cues together with structured reinforcement activities. During its formative development, learners were first shown proposed visual representations individually and asked, "Ini gambar apa?" ("What is this picture of?"). The activity intentionally examined what learners could recognise and name before the corresponding letters and sounds were formally introduced. Their spontaneous responses provided information about the recognisability of the cues, the labels naturally associated with them and the degree of support required for identification.

The resulting recognition patterns were considered together with cue-design characteristics when organising the corresponding letters into progressive instructional groups. Representations that were generally more readily recognised and consistently named could provide comparatively accessible starting points while cues associated with greater naming variation or uncertainty could be introduced later with additional instructional support. This formative process is described in the present study as *recognition before instruction*. Unlike pictorial or multisensory approaches in which visual supports are introduced directly as part of letter teaching, the candidate representations were first examined for how learners spontaneously recognised and named them before formal letter-sound instruction began. The subsequent use of these response patterns to inform the organisation of the corresponding letters is described as *recognition-informed grouping*. This approach does not replace systematic letter-sound teaching. Rather, it introduces a formative step between cue development and formal instruction in which learner evidence contributes to decisions about the selection and sequencing of instructional representations.

Previous research has established the value of pictorial mnemonics, multisensory literacy instruction and dyslexia-responsive design (Ehri et al., 1984; Shmidman & Ehri, 2010; Abdul Aziz et al., 2022; Hall et al., 2023; Lorusso et al., 2024). Comparatively less attention has been given to whether candidate visual cues are recognised and named as intended before they are incorporated into formal letter teaching and how these responses can contribute to the grouping and sequencing of language-specific instructional materials. This represents a

particularly relevant gap for Bahasa Melayu, where multilingual naming patterns may influence the relationship between a familiar visual representation and its intended instructional label.

The distinctive contribution of the present study therefore lies not in testing whether pictorial mnemonics improve reading outcomes but in examining how learner recognition can function as formative design evidence prior to instruction. Specifically, the study investigates how spontaneous recognition and naming of candidate visual cues can inform the subsequent grouping and sequencing of letters within a Bahasa Melayu early literacy module for learners with dyslexia.

Accordingly, this study reports a formative classroom evaluation conducted during the development of the icon-based letter component of BACAdys Jilid 1. The purpose was not to assess reading achievement or intervention effectiveness. Rather, the study examined how learners with dyslexia responded to the proposed visual representations and how patterns of recognisability and naming informed their subsequent instructional grouping.

The study was guided by the following research questions:

RQ1. How did learners with dyslexia respond to the visual cues developed for BACAdys Jilid 1?

RQ2. What patterns of image recognisability and alternative naming were observed during classroom use?

RQ3. How did these recognition patterns inform the grouping and instructional sequencing of letters in BACAdys Jilid 1?

Literature Review

Dyslexia, Letter Recognition and Letter–Sound Learning

Successful early reading requires learners to develop stable knowledge of both letter identity and letter–sound correspondence. These skills allow learners to move from recognising individual graphemes towards blending sounds, decoding syllables and eventually recognising words with increasing automaticity. For learners with dyslexia, however, the acquisition of these foundational relationships may be slower and less stable because difficulties in phonological processing can interfere with the development and retrieval of grapheme–phoneme associations (Snowling et al., 2020).

Research on reading intervention continues to emphasise the importance of explicit and systematic instruction in foundational reading skills. Hall et al. (2023), in a systematic review and meta-analysis of four decades of reading intervention research involving elementary learners with or at risk for dyslexia, highlighted the continuing importance of direct instruction targeting word-reading and related foundational processes. More recent work on structured multisensory phonics has similarly reinforced the value of explicit, cumulative and carefully sequenced instruction for learners showing characteristics associated with dyslexia (de Oliveira et al., 2026).

Difficulty with letter learning should not be understood only as failure to remember an alphabetic symbol. Letter knowledge requires the integration of visual, phonological and orthographic information. Learners must discriminate the visual form of a letter, retrieve its

associated sound and maintain the relationship sufficiently consistently for later decoding. Studies of dyslexia have identified difficulties in visual-attentional and orthographic processing among some learners, particularly when written information involves competing or visually crowded elements (Lobier et al., 2014; Gori & Facoetti, 2015). These findings complement rather than replace phonological explanations of dyslexia and indicate that the design of early reading materials may influence how accessible letter-level information is to learners.

For beginning readers, this is particularly relevant when several letters share similar visual characteristics. Learners who have not yet developed stable orthographic representations may confuse letters, rely on partial features or require repeated exposure before recognition becomes consistent. Consequently, instructional support should reduce unnecessary visual competition while strengthening the relationship between the target grapheme and its phonological representation.

Multisensory approaches offer one means of providing this additional support. Rather than depending solely on visual exposure to printed letters, multisensory literacy instruction combines seeing, hearing, saying, writing or manipulating representations of the target symbol. Malaysian research has previously reported positive outcomes from multisensory approaches designed to support alphabet recognition and mastery among learners with dyslexia (Majzub et al., 2012). Contemporary dyslexia intervention literature likewise continues to support structured instruction in which multiple forms of reinforcement are integrated around clearly defined literacy targets rather than used as unrelated enrichment activities.

For the present study, these findings support the use of additional visual cues during the earliest stage of BACAdys. The purpose of the cues is not to replace explicit letter–sound instruction but to provide a temporary and meaningful scaffold through which an abstract grapheme can be connected to a familiar representation and its corresponding sound.

Visual Mnemonics and Icon-Based Support for Letter Learning

Visual mnemonics have long been used to support early letter learning by connecting abstract alphabetic symbols with familiar and meaningful representations. Rather than requiring learners to remember a grapheme in isolation, a visual mnemonic provides an additional cue that may make the letter easier to recall during instruction. Early work by Ehri et al. (1984) demonstrated that pictorial mnemonics were particularly effective when the picture and target letter were meaningfully integrated. Shmidman and Ehri (2010) later reported that embedded picture mnemonics could facilitate letter learning, reduce confusion between letters and support retention more effectively than less integrated picture–letter associations.

The instructional value of such representations depends on more than visual attractiveness. A useful cue should provide a meaningful relationship between the representation and the intended learning target. In early literacy instruction, familiar images can function as an entry point by allowing learners to begin with concepts they already recognise before moving towards more abstract alphabetic knowledge. This is consistent with broader multisensory approaches in which visual, auditory, kinesthetic and tactile forms of support are combined

around clearly defined literacy targets rather than used as unrelated activities. Recent intervention research has continued to support structured multisensory approaches for learners with or at risk for dyslexia (de Oliveira et al., 2026).

However, visual familiarity alone does not guarantee that an image will function effectively as an instructional mnemonic. A representation may be easily recognised while still producing several possible verbal labels. This distinction is particularly important when the visual cue will later be used to introduce a specific letter. If the learner retrieves a label different from the one intended by the designer, the cue may not provide the expected pathway towards the target letter during subsequent instruction.

A visual representation may therefore be recognised correctly at the semantic level while still producing several plausible verbal labels. In such cases, the learner understands the represented concept but does not necessarily retrieve the specific label anticipated by the designer. From an instructional-design perspective, the cue may remain visually accessible while requiring greater lexical support before it is used in subsequent letter instruction.

Two characteristics are particularly useful for considering the formative suitability of icon-based letter cues: visual recognisability and naming consistency. Visual recognisability concerns how readily learners identify the concept represented by the image. Naming consistency concerns the extent to which learners use the intended label rather than a competing term. These characteristics are relevant before formal letter–sound teaching because they help determine whether the selected representation provides a sufficiently familiar and stable starting point for instruction.

Recent dyslexia-friendly design research supports the broader principle that instructional features should be evaluated according to how learners actually respond to them. Abdul Aziz et al. (2022), in a systematic review of dyslexia-friendly tangible user interfaces, highlighted the importance of involving children during design and prototype evaluation. Similarly, Lorusso et al. (2024) demonstrated considerable variation in the visual and auditory presentation preferences of children with dyslexia, suggesting that design features should not be assumed to work uniformly across learners. Jamali et al. (2023) also reported the value of learner interaction and engagement in tangible learning environments while Abdul Aziz et al. (2026) further developed design guidelines for tangible interfaces intended to support reading and spelling among children with dyslexia.

These studies collectively support an iterative and learner-informed approach to visual instructional design. Rather than assuming that an image selected by an adult designer will automatically be interpreted as intended, learner responses can provide formative information about whether the representation is sufficiently clear, familiar and stable for instructional use. Recent dyslexia-friendly design research has similarly emphasised learner involvement, individual variation and iterative evaluation during the development of instructional supports (Abdul Aziz et al., 2022; Jamali et al., 2023; Lorusso et al., 2024; Abdul Aziz et al., 2026).

The present study extends this learner-informed principle to the organisation of instruction itself. It focuses on an earlier formative stage than studies examining whether pictorial

mnemonics or multisensory approaches support subsequent literacy learning (Ehri et al., 1984; Shmidman & Ehri, 2010; Majzub et al., 2012; Hall et al., 2023). Candidate cues were first examined through spontaneous learner recognition and naming before they were incorporated into formal letter–sound instruction. Recognition patterns were then considered when organising the corresponding letters into instructional groups.

In this study, recognition-before-instruction therefore refers to evaluating the accessibility of candidate visual cues prior to formal teaching, whereas recognition-informed grouping refers to using that learner evidence, together with design considerations, to inform subsequent instructional sequencing. Learner recognition is consequently treated not merely as an outcome to be achieved through instruction but as formative evidence that can contribute to the design of the instruction itself.

Bahasa Melayu Literacy and the Need for Language-Specific Visual Cues

Bahasa Melayu has relatively consistent grapheme-phoneme correspondences, which can support early decoding once learners have established stable knowledge of individual letters and sounds. However, struggling readers and learners with dyslexia may still experience difficulties in phonological processing, blending and automatic word recognition. Research involving early Bahasa Melayu readers has therefore emphasised the importance of systematic grapheme–phoneme instruction and carefully sequenced foundational literacy skills (Lee & Wheldall, 2011; Lee, 2021).

The linguistic structure of Bahasa Melayu also has implications for the design of instructional materials. Early reading typically progresses from letter recognition towards open syllables, closed syllables and increasingly complex word structures. Analysis of Malay reading materials has similarly highlighted the need to consider the linguistic characteristics and word structures of Bahasa Melayu when developing remedial reading programmes (Lee et al., 2012). For learners with dyslexia, this progression requires materials that provide repeated and accessible opportunities to consolidate foundational skills before moving towards more complex reading patterns.

Visual cues used during the earliest stage of instruction should therefore be appropriate not only to the learner's developmental needs but also to the language being taught. Visual mnemonic systems developed for English cannot necessarily be transferred directly to Bahasa Melayu because the same object may have a different lexical label and initial sound across languages. An image that provides a useful phonological association in one language may therefore become less suitable when the learner retrieves its Bahasa Melayu equivalent.

This issue is especially relevant in Malaysia's multilingual environment. Learners may spontaneously use Bahasa Melayu, English or another familiar term when identifying the same representation. For example, a visual cue may be correctly understood at the semantic level but labelled using a word different from that anticipated by the designer. Such variation is important when the image is intended eventually to support the introduction of a particular letter.

Language-specific visual design therefore requires attention to familiarity, lexical accessibility and contextual relevance. The selected representation should be meaningful to the learner

while also being sufficiently stable in the language of instruction. This principle is consistent with broader dyslexia-friendly design research that emphasises culturally responsive, user-informed and contextually appropriate instructional supports (Abdul Aziz et al., 2022; Lorusso et al., 2024).

Previous Malaysian research has explored multisensory, computer-assisted and dyslexia-responsive approaches to Bahasa Melayu literacy (Majzub et al., 2012; Daud & Abas, 2013; Hamid et al., 2015). Research on Bahasa Melayu literacy has also emphasised the importance of language-specific grapheme–phoneme knowledge, phonological processing and carefully sequenced foundational reading skills (Lee & Wheldall, 2011; Lee et al., 2012; Lee, 2021). Nevertheless, comparatively limited attention has been given to the specific question of how learners recognise and name candidate visual cues before those cues are incorporated into early Bahasa Melayu letter instruction.

The present study addresses this narrower design issue by examining learners' spontaneous responses to visual representations developed for BACAdys Jilid 1 before formal letter–sound teaching. By using patterns of recognisability and naming as formative evidence for subsequent instructional grouping, the study provides a language-specific example of how learner responses can contribute to the organisation and sequencing of early Bahasa Melayu literacy materials.

Methodology

Research Design

This study employed a formative classroom-based descriptive design to examine how learners with dyslexia responded to the visual letter cues developed for BACAdys Jilid 1 and how these responses informed the subsequent grouping and instructional sequencing of letters.

A formative design was appropriate because the purpose of the study was not to evaluate the effectiveness of BACAdys as a reading intervention. Rather, the study sought practical classroom-based evidence concerning the recognisability of the proposed visual representations before they were used for formal letter–sound instruction. Particular attention was given to how readily learners recognised each representation, the labels they spontaneously produced and the degree of support required during identification.

The broader formative process involved four stages. First, candidate visual letter cues were developed according to the identified design considerations. Second, learners' responses to the candidate cues were observed and documented, with attention to patterns of recognisability and naming. Third, these response patterns were considered together with cue-design characteristics to inform the grouping and sequencing of the corresponding letters. Fourth, the resulting instructional groups were incorporated progressively into subsequent letter–sound teaching in BACAdys Jilid 1.

The study was descriptive rather than experimental. No control group, pre-test–post-test comparison or measure of reading improvement was employed. The overall process reflected the recognition-before-instruction principle, in which learners' responses to the candidate visual representations were examined before the corresponding letter forms and sounds

were introduced progressively. Figure 1 illustrates the formative development and instructional grouping process used in the study.

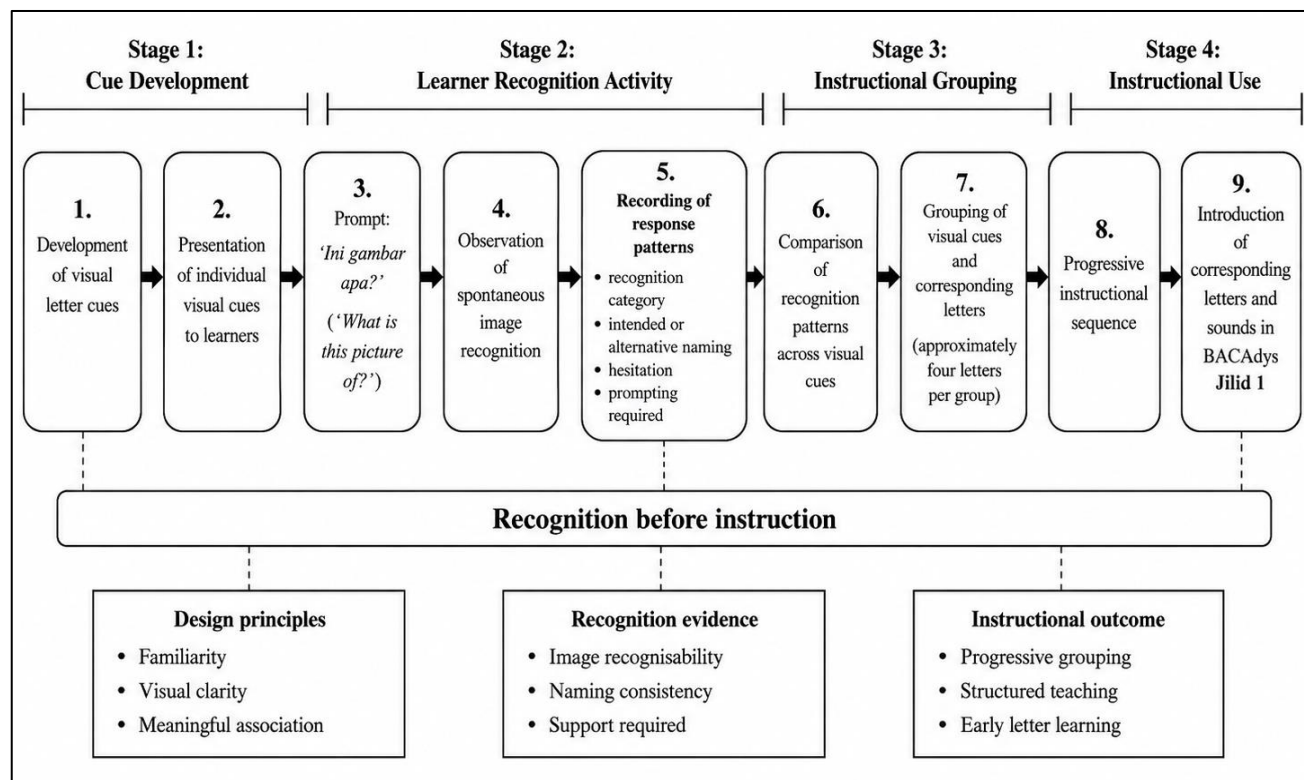


Figure 1 Formative development and instructional grouping process of the BACAdys letter cues

Participants and Research Setting

The present analysis included seven learners aged 7–10 years. All seven had been formally identified with dyslexia and their status was documented in existing records at the learning centre. Purposive inclusion was appropriate because the learners were receiving literacy support and represented the intended learner population for BACAdys.

The study was conducted during routine Bahasa Melayu literacy sessions at a learning centre in Malaysia. Each learner participated individually in the visual cue recognition activity. Conducting the activity within a familiar instructional setting allowed learner responses to be observed under natural classroom conditions rather than in an experimental or laboratory environment.

Structured classroom observation records constituted the primary source of data. Available classroom recordings were also reviewed to verify or clarify learner responses documented during the activity where necessary.

Development of the Icon-Based Letter Cues

The visual cues examined in this study were developed as part of the foundational letter-learning component of BACAdys Jilid 1. The cues were intended to provide learners with a familiar visual entry point before the corresponding letters and sounds were introduced during instruction.

Depending on the characteristics of the target letter, the cues drew on familiar objects, actions, sounds or other meaningful visual associations. Where appropriate, elements of the representation were also designed to reflect or incorporate characteristics of the target letter form, allowing the familiar image and the grapheme to be visually connected. The system therefore did not rely on a single pictorial mechanism and did not require every cue to operate through the initial sound of an object name.

Several practical considerations guided the initial development of the candidate cues. These included familiarity with the represented concept, visual clarity, simplicity, meaningful association with the target letter and suitability within the Bahasa Melayu context. The principal design considerations are summarised in Table 1.

Table 1

Design Considerations for the BACAdys Icon-Based Letter Cues

Design consideration	Description
Concept familiarity	Representations were based on objects, actions, sounds or concepts expected to be familiar to learners.
Visual clarity	Cues were designed to present the intended concept clearly and minimise unnecessary visual ambiguity.
Simplicity	Representations emphasised essential features rather than excessive decorative detail.
Meaningful association	Each cue was intended to provide a meaningful connection with the target letter, sound or form.
Grapheme-related visual form	Where appropriate, visual elements reflected or incorporated characteristics of the target letter form.
Language suitability	Representations were considered within the Bahasa Melayu context, including the possibility of alternative everyday labels.
Learner recognisability	Candidate cues were subsequently examined through learners' spontaneous recognition before instructional grouping.

Attention to language suitability was particularly important because a representation that appeared visually familiar could still be described using different everyday terms by different learners. Such variation was relevant because the cues were intended to support subsequent letter instruction within a Bahasa Melayu learning context.

The cues were therefore treated as candidate instructional representations rather than assumed to be equally suitable from the outset. Their recognisability was examined through direct learner responses before the corresponding letters were organised into instructional groups. This allowed the grouping process to be informed by classroom evidence rather than solely by conventional alphabetical order or adult judgement.

The complete BACAdys visual cue system is not reproduced in this article. Selected examples are discussed only where necessary to illustrate learner responses and the resulting formative design decisions.

Observation Instrument

Learner responses were documented using a structured observation record developed for the formative activity. The instrument focused primarily on the observed ease of image recognition after each visual cue was presented.

Recognition was classified using four descriptive categories, as shown in Table 2.

Table 2

Observation Categories for Visual Cue Recognition

Category	Recognition level	Operational description
1	Very fast	Image identified immediately or with minimal observable hesitation
2	Fast	Image identified readily following brief hesitation
3	Moderate	Noticeable time required before an identification was provided
4	Slow	Substantial hesitation, repeated consideration or additional support required

Note. The categories represented descriptive classroom observations rather than precise response-time measurements. No stopwatch-based or millisecond response-time measurement was used.

In addition to the recognition category, qualitative information was recorded for each response. This included the actual word produced by the learner, alternative naming, incorrect identification, hesitation, repeated attempts and prompting where applicable. Recording these observations separately was important because learners could recognise the general concept represented by a visual cue while using a label different from the one intended during its development.

Available classroom recordings were reviewed alongside the written observation records to verify or clarify learner responses where necessary. The recordings were used as supporting material for the classroom observations rather than as a separate source of measurement.

Visual Cue Recognition Procedure

The recognition activity was conducted individually during routine Bahasa Melayu literacy sessions. Each learner was shown one visual cue at a time and the corresponding letter name or sound was not introduced before the learner responded.

For each visual representation, the learner was asked one primary question:

"Ini gambar apa?" ("What is this picture of?")

The prompt was deliberately simple because the activity was intended to identify what the learner spontaneously recognised from the representation rather than to assess letter knowledge or letter-sound association. The researcher recorded the learner's recognition category together with the actual word produced. Alternative naming, incorrect identification, hesitation and prompting were documented where applicable.

After all candidate cues had been presented, responses were reviewed across the seven learners to identify recurring patterns of recognisability and naming. Cues that were

recognised more readily and consistently were distinguished from those associated with greater hesitation, alternative labels or additional support.

These patterns contributed to the organisation of the corresponding letters into manageable instructional groups, generally consisting of approximately four letters. Earlier groups prioritised cues showing stronger recognisability and more stable responses while later groups increasingly included cues with naming variation or a greater need for instructional mediation. Group placement was therefore informed by learner responses together with the practical design characteristics of each cue rather than treated as a strict ranking of difficulty. Importantly, the recognition and grouping process occurred before the formal teaching of the corresponding letters and sounds. Once the instructional groups had been established, the visual cues were incorporated into BACAdys Jilid 1 and used progressively during subsequent letter instruction.

Data Analysis

The data were analysed descriptively in accordance with the formative purpose of the study. Observation records were organised according to learner and visual cue. Recognition categories were reviewed together with the accompanying qualitative notes to identify recurring patterns in image recognisability, intended naming, alternative naming, hesitation, incorrect identification and prompting.

Responses were compared across the seven learners to identify cues that demonstrated relatively stronger or weaker recognisability and greater or lower consistency in naming. Greater emphasis was placed on recurring patterns across learners rather than isolated responses from an individual participant. Available classroom recordings were reviewed where necessary to verify or clarify the written observation records.

The resulting patterns were interpreted as formative design evidence rather than measures of intervention effectiveness. Recognition and naming patterns were considered alongside the design characteristics of each cue when determining instructional placement. Recurring evidence of strong accessibility supported earlier placement while naming variability, hesitation or a greater need for support contributed to decisions about later introduction.

The resulting sequence was not treated as a psychometric ranking of cue or letter difficulty. These observations subsequently informed the grouping of the corresponding letters in BACAdys Jilid 1. No inferential statistical analysis was conducted because the study was intended to support instructional design decisions rather than establish statistically generalisable differences among the visual cues.

Ethical Considerations

Parental consent had been obtained for the learners included in the present analysis and for the use of their classroom observation records and recordings for research purposes. Participant confidentiality and privacy were maintained throughout the study and no names or personally identifying information are reported in this article. The classroom recordings used to verify or clarify learner responses did not capture the learners' faces. The recordings were retained by the researcher and were not publicly shared. Observation records and

recordings were used only to review responses documented during the formative classroom activity.

Results and Discussion

The findings are organised according to the three research questions. The analysis first examines patterns in the recognisability of the visual cues, followed by differences in intended and alternative naming. The final sections explain how these observations informed the instructional grouping of letters and what the findings suggest for the design of visual letter cues for Bahasa Melayu learners with dyslexia. As the study was formative and descriptive, the findings are interpreted as evidence for instructional design rather than as indicators of intervention effectiveness.

Patterns of Visual Cue Recognition

The classroom observations showed variation in both the recognisability of the proposed visual cues and the consistency of the labels produced. Some representations elicited stable naming across all seven learners while others were understood at a broader conceptual level or produced uncertainty about the specific intended label. These differences indicated that visual accessibility involved more than whether an image was simply recognised or not recognised.

Table 3 presents four representative examples selected to illustrate the main response patterns without reproducing the complete BACAdys visual cue system or the full cue-by-cue response dataset.

Table 3

Selected Visual Cue Recognition and Naming Responses (n = 7)

Representative cue	Observed response distribution	Recognition and naming pattern	Formative interpretation
l – lampu (lamp)	7/7 identified the representation as lampu	Complete concept recognition with stable naming	Highly recognisable representation suitable for early instructional grouping
s – ular (snake)	7/7 identified the snake-like representation as ular	Complete concept recognition with stable image naming	Highly recognisable representation; the target sound association was introduced later during instruction
f – feri (ferry)	3/7 said feri; 4/7 said kapal (boat/ship)	All seven recognised the water-vessel concept but naming differed in specificity	Semantic recognition was strong while the intended lexical label required additional support
w – wau (traditional kite)	4/7 said layang-layang; 3/7 were uncertain and did not provide a confident specific label	Recognition and naming were less stable across learners	Greater instructional mediation was required to establish the intended wau association

Among the selected examples, the cues associated with l–lampu (lamp) and the snake-like representation associated with s–ular (snake) showed the most stable naming patterns: all

seven learners (7/7) identified the representations as *lampu* and *ular* respectively. In contrast, the f-*feri* (ferry) cue produced consistent semantic recognition but less specific naming. Three learners (3/7) used the intended label *feri* while four (4/7) used the broader but semantically appropriate term *kapal* ("boat/ship"). The w-*wau* (traditional kite) cue showed greater naming uncertainty: four learners (4/7) identified the object as *layang-layang* ("kite") while three (3/7) were uncertain and did not provide a confident specific label.

Importantly, visual recognisability and naming consistency did not always occur together. A learner could understand the general meaning of a representation while producing a broader or alternative label. For this reason, interpretation considered both the descriptive recognition category and the actual word produced rather than treating every non-target label as an incorrect recognition response. For the ***ς*** cue, the recognition activity concerned identification of the snake representation; its instructional association with the target sound was introduced only during later teaching.

Taken together, the selected examples demonstrate three formative patterns: stable recognition and naming, successful semantic recognition with lower lexical specificity and greater uncertainty in naming. These patterns illustrate why cue evaluation considered both what learners appeared to recognise and the lexical label they could spontaneously retrieve. This distinction supports learner-informed approaches to dyslexia-friendly design, which emphasise evaluating instructional features through actual learner interaction rather than assuming uniform interpretation (Abdul Aziz et al., 2022; Lorusso et al., 2024; Ismail & Jaafar, 2015).

Alternative Naming and Visual Interpretation

A notable pattern involved cues that learners understood correctly at the semantic level but named using a broader or more familiar term. Such responses were particularly informative because the visual cues were ultimately intended to support subsequent letter instruction within a Bahasa Melayu learning context.

The f-*feri* cue illustrates this distinction particularly clearly. Three learners used the intended word *feri* while four responded with *kapal*. The latter responses were semantically appropriate rather than wholly incorrect because a ferry belongs to the broader category of water vessels. The formative issue was therefore not failure to recognise the represented concept but lower specificity in retrieving the particular label intended for subsequent instruction.

A related but less stable pattern occurred with w-*wau*. Four learners identified the object as *layang-layang* while three remained uncertain and did not provide a confident specific label. The visual representation was therefore accessible to some learners but did not produce consistent naming across the group. Together, the *feri* and *wau* examples show that semantic recognisability and lexical specificity should be considered separately during visual-cue development. A cue may be meaningful at the conceptual level while still requiring additional teaching to establish the particular label intended for the instructional sequence.

The issue is particularly relevant within Malaysia's multilingual environment, where learners may spontaneously retrieve a Bahasa Melayu word, an English equivalent or another familiar

category label when interpreting the same representation. Previous Bahasa Melayu literacy research has demonstrated the importance of attending to language-specific phonological and orthographic characteristics when designing reading support (Lee et al., 2012; Lee, 2021). Dyslexia-friendly instructional design research similarly stresses the need for materials to respond to the linguistic and contextual characteristics of their users (Abdul Aziz et al., 2022; Abdul Aziz et al., 2026).

The findings therefore suggest that cue selection cannot depend solely on visual familiarity. The vocabulary naturally elicited by the representation also needs to be considered, particularly when a broader or alternative label is semantically appropriate but differs from the intended instructional term. This complements earlier research on pictorial mnemonics showing that visual representations are most useful when they establish meaningful relationships with the learning target rather than functioning merely as decorative images (Ehri et al., 1984; Shmidman & Ehri, 2010).

Recognition-Based Grouping of the Letter Cues

The observed recognition and naming patterns were subsequently used, together with the design characteristics of the cues, to inform the instructional grouping of the corresponding consonants. The earliest group contained cues that were generally more readily recognised and associated with relatively stable responses. In particular, the cues corresponding to b, m, s and l demonstrated comparatively strong accessibility during the formative activity. The complete naming consistency observed for the selected l and s examples provided additional support for their placement in the first instructional group.

The second instructional group also contained cues that were generally accessible while later groups increasingly included mixed patterns of recognition, broader naming or a greater need for instructional mediation. Importantly, later placement did not necessarily indicate complete failure to recognise a cue. The f–feri example showed that all seven learners understood the broader water-vessel concept even though four used kapal instead of feri. By contrast, the w–wau example showed greater uncertainty, with only four learners providing the familiar label layang-layang and three remaining unsure. Such patterns contributed to decisions about the amount of support required during later introduction.

The resulting consonant sequence in BACAdys Jilid 1 was organised into five instructional groups, as shown in Table 4. The table summarises the broad formative pattern associated with each stage without reproducing the complete icon set.

Table 4

Recognition-Informed Instructional Grouping of Consonants in BACAdys Jilid 1

Instructional group	Letters	General formative pattern
Group 1	b, m, s and l	Cues generally showed strong recognisability and relatively stable responses
Group 2	c, g, n and d	Cues remained generally accessible with some variation across learners
Group 3	r, p, j and t	Recognition and naming patterns were more mixed across selected cues
Group 4	k, f, h and y	Selected cues showed greater naming variation or required additional support

Group 5	w, v and z	Selected cues required greater mediation because of naming uncertainty, lower familiarity or greater interpretive variability
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The grouping should not be interpreted as a psychometric ranking of inherent letter difficulty. Rather, it represents a practical instructional progression informed by the interaction between learner responses and cue-design considerations. A cue could therefore be visually recognised while still being positioned later when the intended label was less consistently retrieved or when greater instructional mediation was considered beneficial.

The use of learner evidence to inform instructional organisation is consistent with broader user-centred and dyslexia-responsive design principles. Previous work has emphasised involving children during the development and evaluation of learning supports and recognising that instructional features may not function uniformly across learners (Abdul Aziz et al., 2022; Jamali et al., 2023; Abdul Aziz et al., 2026). The present findings extend this principle from the evaluation of individual instructional features to the sequencing of instruction itself. In BACAdys Jilid 1, learner recognition and naming patterns were used not only to consider whether individual visual cues appeared sufficiently accessible but also to inform the order in which groups of corresponding letters would subsequently be introduced. This distinction clarifies the contribution of recognition-informed grouping. Rather than treating learner recognition solely as an outcome of teaching, the formative process used recognition and naming responses as evidence before formal letter–sound instruction began. Cues associated with comparatively stable recognition and naming could provide earlier instructional entry points while cues showing greater lexical variation or uncertainty could be introduced later with additional mediation. The resulting grouping therefore represents a learner-informed instructional sequence rather than a fixed hierarchy of letter difficulty.

The findings also clarify the role of recognition before instruction. This principle should not be interpreted as an alternative to explicit letter–sound teaching or as evidence that visual recognition alone produces literacy learning. Instead, it represents a preparatory design stage in which candidate visual cues are examined before they are incorporated into structured instruction. In this respect, the study differs from research that primarily examines the use or effectiveness of pictorial mnemonics and multisensory supports during instruction (Ehri et al., 1984; Shmidman & Ehri, 2010; Hall et al., 2023). The contribution lies in demonstrating how learner responses to proposed cues can inform the organisation of instructional materials before later letter–sound teaching.

Implications for Icon-Based Letter Design

The findings indicate that the design of visual supports for early letter learning involves more than selecting attractive or familiar pictures. A potentially useful cue should be sufficiently recognisable to the intended learner and should minimise unnecessary ambiguity in interpretation. Where several plausible labels compete, additional instructional support may be required before the representation can function consistently within a structured literacy sequence.

This consideration is consistent with previous work demonstrating the value of multisensory and visually supported approaches for learners with dyslexia. Malaysian research has reported benefits associated with multisensory activities for alphabet recognition and

mastery (Majzub et al., 2012) while more recent work has examined learner engagement with tangible interfaces and dyslexia-friendly design features (Jamali et al., 2023; Abdul Aziz et al., 2026). Recent intervention research also continues to support structured and explicit approaches to foundational literacy learning for children with or at risk for dyslexia (Hall et al., 2023; de Oliveira et al., 2026).

A further consideration concerns the relationship between the visual representation and the target grapheme. In BACAdys, selected cues were designed so that characteristics of the letter form could, where appropriate, be reflected or incorporated within the visual representation. This principle is conceptually related to embedded picture mnemonic research, where stronger integration between an image and the target letter has been shown to facilitate early alphabet learning (Ehri et al., 1984; Shmidman & Ehri, 2010). The present study did not directly test whether this visual integration improved letter learning but the principle informed the development of the candidate cues.

The contribution of the present study therefore lies primarily in the formative design process. Rather than treating the proposed icons as finished instructional elements, learner responses were used to examine their recognisability, identify naming variation and inform their subsequent instructional grouping. This provides a practical example of how small-scale classroom observations can contribute to the development of language-specific literacy materials.

The findings should nevertheless be interpreted within the limits of the study. The present analysis was based on seven learners and the recognition activity examined spontaneous image identification and naming rather than subsequent reading achievement. The study therefore does not establish that the visual cues or recognition-based grouping improve letter learning, decoding or reading performance. Future research could evaluate the resulting instructional sequence with a new sample using an intervention design capable of examining changes in letter knowledge and early reading outcomes.

Overall, the findings suggest that visual cues can be treated as learner-tested instructional representations rather than fixed design elements. For the development of BACAdys Jilid 1, examining what learners recognised and how they named the representations before formal letter instruction provided practical formative evidence for refining and sequencing the foundational letter-learning component.

Conclusion

This study examined the formative development and grouping of icon-based letter cues for BACAdys Jilid 1 using classroom observation records from seven learners with dyslexia. The findings showed variation in both the recognisability of the proposed visual representations and the specificity with which learners named them. The selected l–lampu and s–ular cues were named consistently by all seven learners while f–feri demonstrated successful semantic recognition with broader naming and w–wau produced greater naming uncertainty. These patterns provided practical evidence for considering both concept recognition and naming stability when determining the instructional placement of visual cues.

A central contribution of the study is the application of recognition before instruction and recognition-informed grouping as complementary formative design principles. Rather than

introducing visual cues directly as part of letter teaching or relying solely on conventional alphabetical order and adult judgement, learner responses were first examined before formal letter–sound instruction. These responses were then considered, together with cue-design characteristics, when organising the corresponding letters into a progressive instructional sequence. The contribution therefore lies in using learner recognition not merely as an instructional outcome but as formative evidence for the design and sequencing of instruction. This approach also highlights the importance of visual clarity, meaningful association, language suitability and learner recognisability when developing early literacy materials for Bahasa Melayu learners with dyslexia.

The findings should be interpreted as formative design evidence rather than evidence of instructional effectiveness. The study involved a small group of learners and did not directly measure subsequent letter–sound learning or reading achievement. Future research could evaluate the resulting icon-based instructional sequence using a new sample and an intervention design that directly examines letter knowledge, letter–sound learning and early reading outcomes.

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Conflict of Interest

The authors declare no conflict of interest.

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References

- Abdul Aziz, N. I., Husni, H. & Hashim, N. L. (2022). Dyslexia-friendly design features for tangible user interfaces: A systematic literature review. *International Journal of Information and Learning Technology*, 39(4), 360–372. <https://doi.org/10.1108/IJILT-11-2021-0170>
- Abdul Aziz, N. I., Husni, H. & Hashim, N. L. (2026). Development of tangible user interfaces design guideline: An experimental study to assist children with dyslexia in learning to read and spell. *International Journal of Information and Learning Technology*, 43(2), 125–140. <https://doi.org/10.1108/IJILT-07-2024-0154>
- Daud, S. M. & Abas, H. (2013). 'Dyslexia Baca' mobile app—The learning ecosystem for dyslexic children. In *2013 International Conference on Advanced Computer Science Applications and Technologies (ACSAT)* (pp. 412–416). IEEE. <https://doi.org/10.1109/ACSAT.2013.87>
- de Oliveira, V. R. V., Guimarães, S. R. K., Roza, S. A. & Conerado, S. A. (2026). Effects of a structured multisensory phonics-based intervention on children identified as showing risk signs for dyslexia: A longitudinal study in Brazilian public schools. *Frontiers in Education*, 11, 1703169. <https://doi.org/10.3389/feduc.2026.1703169>
- Ehri, L. C., Deffner, N. D. & Wilce, L. S. (1984). Pictorial mnemonics for phonics. *Journal of Educational Psychology*, 76(5), 880–893. <https://doi.org/10.1037/0022-0663.76.5.880>
- Gori, S. & Facoetti, A. (2015). How the visual aspects can be crucial in reading acquisition? The intriguing case of crowding and developmental dyslexia. *Journal of Vision*, 15(1), Article 8. <https://doi.org/10.1167/15.1.8>
- Hall, C., Dahl-Leonard, K., Cho, E., Solari, E. J., Capin, P., Conner, C. L., Henry, A. R., Cook, L., Hayes, L., Vargas, I., Richmond, C. L. & Kehoe, K. F. (2023). Forty years of reading intervention research for elementary students with or at risk for dyslexia: A systematic review and meta-analysis. *Reading Research Quarterly*, 58(2), 285–312. <https://doi.org/10.1002/rrq.477>
- Hamid, S. S. A., Admodisastro, N. & Ghani, A. A. A. (2015). Computer-based learning model to improve learning of the Malay language amongst dyslexic primary school students. In *Proceedings of the Asia Pacific HCI and UX Design Symposium* (pp. 37–41). ACM. <https://doi.org/10.1145/2846439.2846448>
- Ismail, R. & Jaafar, A. (2015). Interface design for young dyslexics: A survey on visual representation. *Jurnal Teknologi*, 75(3), 103–109. <https://doi.org/10.11113/jt.v75.5050>
- Jamali, S. N., Admodisastro, N., Kamaruddin, A. & Hassan, S. (2023). Learning engagement of children with dyslexia through tangible user interface: An experiment. *International Journal of Advanced Computer Science and Applications*, 14(11). <https://doi.org/10.14569/IJACSA.2023.0141186>
- Lee, L. W. (2021). The role of phonological processing in children from a national-type Chinese primary school in Malaysia: Implications for dyslexia assessment. *Australian Journal of Learning Difficulties*, 26(2), 167–178. <https://doi.org/10.1080/19404158.2021.1995014>
- Lee, L. W., Low, H. M. & Mohamed, A. R. (2012). Word count analysis of Malay language textbooks for the purpose of developing a Malay reading remedial programme. *Writing Systems Research*, 4(1), 103–119. <https://doi.org/10.1080/17586801.2012.690713>
- Lee, L. W. & Wheldall, K. (2011). Acquisition of Malay word recognition skills: Lessons from low-progress early readers. *Dyslexia*, 17(1), 19–37. <https://doi.org/10.1002/dys.421>
- Lobier, M. A., Peyrin, C., Pichat, C., Le Bas, J.-F. & Valdois, S. (2014). Visual processing of multiple elements in the dyslexic brain: Evidence for a superior parietal dysfunction. *Frontiers in Human Neuroscience*, 8, 479. <https://doi.org/10.3389/fnhum.2014.00479>

- Lorusso, M. L., Borasio, F., Panetto, P., Curioni, M., Brotto, G., Pons, G., Carsetti, A. & Molteni, M. (2024). Validation of a web app enabling children with dyslexia to identify personalized visual and auditory parameters facilitating online text reading. *Multimodal Technologies and Interaction*, 8(1), 5. <https://doi.org/10.3390/mti8010005>
- Majzub, R. M., Abdullah, M. A. & Aziz, Z. (2012). Effects of a multisensory programme on dyslexic students: Identification and mastery of the alphabet. *Research Journal of Applied Sciences*, 7(7), 340–343. <https://doi.org/10.3923/rjasci.2012.340.343>
- Shmidman, A. & Ehri, L. C. (2010). Embedded picture mnemonics to learn letters. *Scientific Studies of Reading*, 14(2), 159–182. <https://doi.org/10.1080/10888430903117492>
- Snowling, M. J., Hulme, C. & Nation, K. (2020). Defining and understanding dyslexia: Past, present and future. *Oxford Review of Education*, 46(4), 501–513. <https://doi.org/10.1080/03054985.2020.1765756>