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The LANCAR strategy in designing BACA+ media for elementary schools using the design thinking approach

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Abstract: Reading literacy is still a challenge in Indonesia, especially in primary education. Many students have low literacy skills, which shows the need for tools that support integrated learning. This study set out to design a web-based learning platform called BACA+ to help teachers provide differentiated reading instruction. The platform combines reading assessments, adaptive content, interactive activities, and tools to monitor student progress. The research used a design thinking approach with the stages of empathize, define, ideate, prototype, and test. Data was collected through observation, interviews, a survey of 19 teachers, and a literature review. The prototype was tested with 15 primary school students and reviewed by 13 teachers. The result was the BACA+ platform, built using the LANCAR strategy (Level, Assessment, Navigation, Content, Activity, and Reporting). Evaluation showed strong alignment in key areas: reading stages (6.65/7), content differentiation (6.64/7), process differentiation (6.59/7), product differentiation (6.79/7), and usability (6.62/7). The user acceptance score was 4.77 out of 5. Most students were able to complete the learning activities on their own or with little help. The findings suggest that BACA+ has the potential to support the implementation of differentiated reading literacy instruction in primary schools.

Keywords: Differentiated instruction, reading literacy, web-based platform

Abstrak: Literasi membaca menjadi salah satu tantangan yang masih dihadapi di Indonesia, khususnya dalam pendidikan Sekolah Dasar. Tantangan tersebut ditandai oleh rendahnya capaian literasi siswa, sehingga perlu adanya media yang mampu mendukung pembelajaran secara terintegrasi. Penelitian ini bertujuan untuk merancang platform pembelajaran berbasis *website* yang disebut dengan BACA+, untuk mendukung pembelajaran literasi membaca terdiferensiasi melalui integrasi asesmen kemampuan membaca, penyediaan konten yang adaptif, aktivitas interaktif, serta monitoring perkembangan siswa. Metode penelitian menggunakan pendekatan *design research* melalui *design thinking* yang terdiri dari tahap *empathize*, *define*, *ideate*, *prototype*, dan *test*. Proses pengumpulan data melalui observasi, wawancara, survei terhadap 19 guru, dan studi literatur. Purwarupa diujikan kepada 15 siswa sekolah dasar dan dievaluasi oleh 13 guru. Penelitian ini menghasilkan platform BACA+ melalui pengembangan berdasarkan strategi LANCAR (Level, Assesssment, Bavigation, Content, Activity, dan Reporting). Pada tahap evaluasi menunjukkan tingkat kesusaian yang sangat tinggi pada aspek tahap membaca (6,65/7), diferensiasi konten (6,64/7), diferensiasi proses (6,59/7), diferensiasi produk (6,79/7), usability (6,62/7), serta memperoleh nilai penerimaan pengguna sebesar 4,77/5. Proses pengujian kepada siswa menunjukkan bahwa sebagian besar aktivitas pembelajaran dapat diselesaikan secara mandiri atau bantuan yang minimal. Penelitian ini berimplikasi pada temuan yang menunjukkan BACA+ berpotensi mendukung implementasi pembelajaran literasi membaca terdiferensiasi di sekolah dasar.

Kata kunci: Pembelajaran berdiferensiasi, literasi membaca, platform berbasis web

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INTRODUCTION

Reading literacy is a fundamental skill that students must master at the elementary school level, as it serves as the foundation for understanding various subjects (Buyung & Nirawati, 2018). Low reading literacy levels affect academic achievement, independent

learning, and student engagement in the learning process (Nasir et al., 2024; Ningsih et al., 2025). Therefore, improving reading literacy has become one of the top priorities in educational development. Although various literacy improvement programs have been implemented, the reading literacy skills of elementary school students in Indonesia still face serious challenges.

The World Bank, the UNESCO Institute for Statistics, UNICEF, USAID, the FCDO, and the Bill & Melinda Gates Foundation (2022) reported that approximately 53% of 10-year-old children in Indonesia are not yet able to read and understand simple texts (learning poverty) (World Bank et al., 2022). This finding is supported by various studies showing that some elementary school students still struggle to recognize words, comprehend the content of what they read, derive meaning from texts, and connect the information they read to the learning context, resulting in low academic achievement across various subjects (Kim, 2021; Pratiwi & Wiedarti, 2021). Other studies also report that low reading literacy is influenced by limited learning strategies that have not yet been able to accommodate differences in students' reading abilities, resulting in individual learning needs not being optimally met (Adnyana et al., 2024; Snow & Matthews, 2016; Suryaningrat et al., 2023). This situation indicates that the majority of students do not yet possess adequate reading skills to prepare them for the next level of education.

This issue is also evident at both the national and school levels. The 2024 Indonesian Education Report indicates that the proportion of students who have achieved the minimum reading literacy competency remains low (Kementerian Pendidikan, 2024). These findings are consistent with various studies in Indonesia that report that elementary school students' reading literacy skills remain in the low to moderate range and reveal a significant gap in reading ability among students within a single classroom (Juniansyah et al., 2023; Ningsih et al., 2025; Pratiwi & Wiedarti, 2021). The fact that literacy is a national problem which is evident at the school level thus shows the need for instructional innovations that can take account of the diversity in students' reading abilities.

SDN 028 Gumuruh in Bandung provides a concrete illustration of this issue. The school serves 579 students with a teaching staff of only 27, and its 2024 Education Report Card indicates that only 16.67% of students meet or exceed the minimum competency standard, while 30.00% fall below or well below it. Classroom observations further identified 64 students across grades 1 through 6 who had not yet developed basic reading ability. Addressing this kind of variation in student readiness is precisely what the *Kurikulum Merdeka* is differentiated instruction approach is intended to support (Adnyana et al., 2024). These findings underscore that the disparity in reading proficiency remains a genuine problem requiring a systematic response.

One factor contributing to low reading literacy is the suboptimal implementation of differentiated instruction (Suryaningrat et al., 2023). This situation is exacerbated by the lack of adaptive digital media specifically designed to support differentiated reading instruction. Various studies indicate that interactive digital media can support differentiated instruction and enhance student engagement in literacy (Dita et al., 2023; Azhar et al., 2024). Consequently, students with varying reading abilities receive relatively similar learning experiences, meaning that individual learning needs are not yet optimally accommodated.

The results of a comparative study conducted by researchers on platforms currently used in schools namely BUDI (Digital Books, National Literacy Movement) from the Ministry of Education, Culture, Research, and Technology (*Kemdikdasmen*), the *Merdeka Mengajar* website, and Bookbot—show that all three share similarities as teacher learning support systems and web-based media, yet they still have limitations. Bookbot provides an engaging reading experience through illustrations and audio, but does not yet fully support differentiated instruction (Rusniyah, 2024). BUDI offers reading exercises, but has not yet integrated skill assessment and monitoring of student progress (Hutapea & Dongoran, 2025). Meanwhile, *Merdeka Mengajar* is more oriented toward teachers' needs and is therefore less suitable for use by early-grade students (Durriyah et al., 2024). There is currently no platform that integrates reading proficiency assessment, the provision of materials tailored to reading levels, interactive learning activities, and student progress reporting into a single system that supports differentiated instruction.

The results of this comparative study show that most platforms focus on only one aspect, such as providing digital materials, reading exercises, or learning resources for teachers. No platform has yet been found that integrates diagnostic assessments, student grouping based on reading levels, the provision of adaptive materials, interactive learning activities, and student progress reporting into a single system that supports the comprehensive implementation of differentiated instruction. The gap identified in the literature review indicates an opportunity to develop a platform capable of integrating all components of the reading literacy learning process, making it more adaptive and centred on student needs.

Building on this synthesis, the present study introduces BACA+, a web-based reading literacy platform that integrates reading ability identification, differentiated instruction, and student progress monitoring within a single learning ecosystem. The platform's design is organized around the LANCAR strategy, comprising six components: Level, Assessment, Navigation, Content, Activity, and Reporting. Each component of LANCAR is grounded in an established theoretical framework rather than developed independently of prior literature: Level determination draws on Ehri (2014) theory of reading development stages; Assessment is underpinned by the principle of assessment for learning; and Navigation is informed by Interaction Design theory Sharp et al. (2023) interaction design theory for navigation design; Mayer (2020) multimedia learning principles for content development; and Ehri(2014) theory is involved in the use of learning outcome data as a means of monitoring student progress in the reporting section; the integration of these six components is intended to aid in the systematic implementation of differentiated instruction, so that teachers can give teaching which is tailored to meet each student's needs while at the same time keeping a continuous watch on the development of their reading literacy skills.

It is a design-based research project that uses design thinking as its research framework. What makes it novel is the creation of a learning platform based on the LANCAR strategy a conceptual framework that combines reading stage theories, differentiated instruction, formative assessment, media-based learning, user interaction, and learning progress reporting into one web-based platform. As a result, the aim of this research is to develop a digital learning resource that provides a model for carrying out differentiated reading literacy instruction, based on both theoretical foundations and user needs.

METHOD

Research approach

The study uses a design research approach based on the design thinking method, as this approach places the design process at the heart of the research to create design artifacts that are relevant and meet user needs. By means of design research, a thorough understanding of user needs is achieved through an iterative process which consists of problem identification, exploration of possible solutions, and the evaluation of prototypes (user-centered design), thus making sure that the final solutions are not only functional but also appropriate and significant within the context of real-world use (Plomp & Nieveen, 2013). The research validity was examined in two stages: expert validation and user-centered evaluation. For the expert validation, two validators were employed: the principal of SDN 028 Gumuruh, who acted as a domain expert having experience in overseeing elementary school teaching and in carrying out reading literacy programs; and a UI/UX designer, who functioned as a media expert with knowledge of interface design and user experience for digital products. The purpose of this validation was to judge the conceptual appropriateness, the completeness of the features, and the relevance of the artifact to the requirements of differentiated reading literacy instruction. Then, user-centered evaluation was carried out by teachers as the main users to examine the design suitability, user acceptance, and usability of the platform, while students took part as end users during the usability testing phase. This method is in accordance with the principles of design research, which involve combining expert validation with user evaluation in order to improve the artifacts (Liang et al., 2009; McKenney & Reeves, 2018).

Research subjects and location

The study was conducted at SDN 028 Gumuruh, Jl. Cibangkong No. 13, Cibangkong Village, Batununggal Subdistrict, Bandung City. This school was selected through purposive sampling because it represents a public elementary school in a densely populated urban area with a high teacher-to-student ratio (579 students, 27 teachers), limited digital facilities, and real challenges in improving reading literacy. The research subjects consisted of two groups: (1) 19 classroom teachers who completed a descriptive questionnaire to measure the dimensions of the Technology Readiness Index and the need for differentiated instruction; and (2) 6 teachers selected based on the principle of data saturation (Gonen, 2019) for in-depth interviews. These six informants were subsequently coded as Teacher 1 through Teacher 6, comprising three teachers with additional structural roles: Teacher 1 (student affairs, 3rd-grade homeroom teacher), Teacher 2 (curriculum, 5th-grade homeroom teacher), and Teacher 3 (public relations, 6th-grade homeroom teacher), as well as three early-grade teachers—Teacher 4, Teacher 5, and Teacher 6—all of whom are 1st-grade homeroom teachers.

First-grade students were identified as the end users, with data collected through observation and guided interviews. In this study, interviews and questionnaires were used to gain a more comprehensive understanding of early reading instruction in elementary school; the study employed a combination of teacher questionnaires and interviews. Questionnaires were administered to 19 teachers to obtain a general overview of the use of

learning media, technological readiness, literacy activities, and communication with parents. Meanwhile, semi-structured interviews were conducted with 6 teachers to explore in greater depth their experiences, challenges, and needs in implementing early reading instruction.

The prototype testing was carried out with 13 teachers from elementary schools, the intended users of the system. Each of these teachers took part in a face-to-face testing session which lasted about 120 minutes. During this session, they were given an explanation of the purpose of the testing and then asked to go through a number of scenarios relating to the use of the system, including managing student data, assessing reading levels, choosing learning materials, keeping an eye on students' progress, and viewing the evaluation results. The teachers were allowed to use each feature as many times as necessary until they had a good understanding of how the system worked. Once all the scenarios had been completed, the participants completed a questionnaire designed to gather product evaluation. Furthermore, the media prototype testing also included 15 first-grade elementary school students as the main users of the system. The participants were chosen to represent three different levels of reading ability: five students who could not read at all, five who were familiar with the letters, and five who could read simple words. This arrangement was made in order to assess the prototype's suitability for users having a range of literacy levels.

Research procedure: Stages of design thinking

The study followed the five iterative stages of design thinking—Empathize, Define, Ideate, Prototype, and Test—as developed by the Hasso Plattner Institute of Design at Stanford (Hasso Plattner Institute of Design at Stanford University, 2018). The Empathize phase was carried out by making contextual observations in reading classrooms and by holding semi-structured interviews with teachers as well as guided interviews with students. In the Define phase, user needs were synthesised through the process of problem framing. During the Ideate phase, different solutions were explored using the Crazy 8 method and user flows were designed for both teachers and students. For the Prototype phase, a mid-fidelity prototype was developed on the basis of the LANCAR strategy, and in the Test phase evaluation of the prototype was performed by 13 teachers using quantitative instruments.

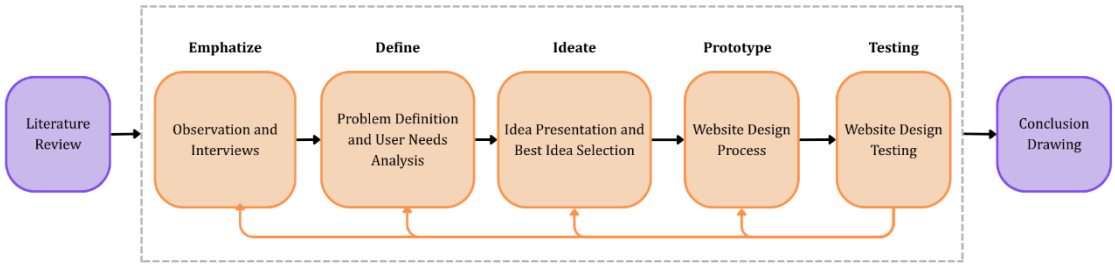


Fig. 1. The Stages of Design Thinking in the BACA+ Platform Development Research

The five stages of design thinking used in this study are presented in Figure 1. Each stage was carried out iteratively to ensure that the artifacts developed met user needs. In the Empathize phase, the researchers carried out observational studies of reading lessons in the classroom, had semi-structured interviews with teachers, and conducted guided interviews with the students in order to find out the users' needs, the problems they

encountered, and their characteristics. In the Define phase they combined the findings from the observations and the interviews into a problem statement (problem framing) in order to determine the key needs that had to be met in the development of the platform.

Next step, during the Ideate phase, a variety of alternative solutions were explored using the Crazy 8 method and user flows for both teachers and students were developed as a foundation for the system design. These results were then put into practice in the Prototype phase by creating a mid-fidelity prototype of the BACA+ platform based on the LANCAR strategy, which includes features for mapping reading ability, assessment, adaptive content, interactive activities, and student progress reporting.

The last stage, Testing, consisted of two types of evaluation. The first was expert validation carried out by the Principal of SDN 028 Gumuruh, who is the domain expert, and the supervising lecturer, who is the academic expert, in order to judge the appropriateness of the platform's concepts, features, and design. The second type of evaluation was a user evaluation which included 13 teachers as the main users to examine the design's suitability, user acceptance, and the platform's usability, as well as usability testing carried out by 15 students as end users. Feedback from each evaluation stage was used to improve the prototype before the final design of the BACA+ platform was produced.

The LANCAR strategy

The LANCAR strategy was formulated as a conceptual framework for the platform, derived from a synthesis of field findings and theoretical foundations: differentiated instruction (Tomlinson, 2017), reading stage theory (Ehri, 2014), multimedia learning (Mayer, 2020), cognitive load theory (Clark & Kimmons, 2023), and interaction design (Sharp et al., 2023). Table 1 presents the components of LANCAR and the corresponding platform features.

Table 1. Strategies and elements of LANCAR

No	Element of LANCAR	Description	Platform Features
1	Level	Mapping of reading stages based on Ehri's (2014) four stages: Pre-alphabetic, partial alphabetic, full alphabetic, and consolidated alphabetic (Ehri, 2014)	Reading level management
2	Assessment	Initial diagnostic assessment to identify students' reading readiness	Reading assessment
3	Navigation	Intuitive information architecture and user flow for both teachers and students	User-friendly information structure and user flow
4	Content	Adaptive reading materials differentiated by reading stage	Material management, reading content
5	Activity	Interactive learning activities that combine visuals, audio, and interactive exercises	Audio, exercises, feedback, interactive reading
6	Reporting	Continuous monitoring of student progress and data-driven decision support	Dashboard, progress tracking

Data Collection

Data were collected through: (1) classroom observations using contextual inquiry to document differentiation in content, process, and products; (2) descriptive questionnaires to measure the dimensions of the Technology Readiness Index (Adhitama et al., 2022) and the need for differentiated instruction; (3) in-depth semi-structured interviews with 6 teachers and guided student interviews; (4) school data documentation, field notes, and educational report card data; (5) a comparative study of three platforms (Bookbot, Budi, and *Merdeka Mengajar*) through direct observation of student interactions; and (6) prototype testing with 13 teachers and 15 students. Data validity was ensured through source triangulation and methodological triangulation (Adhitama et al., 2022).

Instruments and Data Analysis

The instruments used in the testing phase consisted of: (1) a Semantic Differential scale (1–7) to measure design appropriateness (appropriateness of reading stages, content differentiation, process differentiation, product differentiation, and usability); and (2) a Likert scale (1–5) to measure user acceptance (support for instructional planning, student grouping, progress monitoring, instructional decisions, and alignment with the *Kurikulum Merdeka*.

A quantitative descriptive analysis was carried out by calculating the mean (X? = ΣX/N), and this mean was interpreted according to the score interval criteria by using the formula: interval = (maximum score – minimum score) / number of classes. For the Likert scale (1–5), the interpretation criteria are: 1.00–1.80 = Strongly Disagree; 1.81–2.60 = Disagree; 2.61–3.40 = Somewhat Agree; 3.41–4.20 = Agree; 4.21–5.00 = Strongly Agree. For the Semantic Differential scale (1–7), the interpretation criteria are: 1.00–2.20 = Strongly Disagree; 2.21–3.40 = Disagree; 3.41–4.60 = Somewhat Agree; 4.61–5.80 = Agree; 5.81–7.00 = Very Appropriate (Matorevhu & Madzamba, 2025).

RESULTS AND DISCUSSION

The Empathize and Define Stages

Findings from classroom observation: Differentiation of content, process, and product

The observations in this context show that differentiated instruction has not yet been systematically put into practice at SDN 028 Gumuruh. With regard to content differentiation, teachers have detected differences in students' abilities using diagnostic assessments and have divided the students into three groups; yet the instructional materials provided still depend on textbooks and worksheets which are manually prepared by the teachers. Because there is no tiered resource bank, they have to rely on informal knowledge and on external sources. As for process differentiation, the teaching approach remains based on a traditional model in which all students carry out the same activities at the same time. Grouping does take place from time to time but is unstructured, the teacher acting as the main point of control and finding it difficult to attend to the different parts of a large class. Concerning product differentiation, assessment is carried out through oral reading and written assignments that are recorded manually, without keeping long-term records or producing visual representations of progress data to support decision-making based on data. The findings from the observations are given in Table 2.

Table 2. Observation results

No	Aspek	Indicator	Observation Results
1	Content	Source material	Textbooks, student worksheet, additional resources selected individually by the teacher
2	Content	Initial diagnostic assessment to identify students' reading readiness	Three categories of reading ability based on diagnostic assessment
3	Navigation	Material adjustments	Manual; no integrated graded material bank
4	Content	Learning strategies	Classical; grouping is carried out in a limited and inconsistent manner
5	Activity	The role of the teacher	Main facilitator; difficulty dividing attention in large heterogeneous classes
6	Reporting	Evaluation method	Oral reading and written assignments; recorded manually without long-term tracking
7	Reporting	Monitoring progress	No data visualization; progress is saved as a teacher's personal record

Findings from interviews and questionnaires: Differentiated instruction and technological readiness

Challenges in implementing differentiated instruction

Six teachers were interviewed in depth and three major problems were found in the implementation of differentiation. The first of these is that content differentiation is not yet systematic; instead the teachers still group the students manually on the basis of their own assessments. Teachers 3, 4, and 5 consistently gave accounts of similar methods of grouping students:

> "The children were divided into three groups: the group who don't know the alphabet yet, the group who know the alphabet but aren't fluent yet, and the group who are already fluent. Then we printed the worksheets and adapted them for each group."

Second, learning depends heavily on the teacher's personal knowledge, so the system has not yet been able to distribute the burden of interaction. Teacher 1 stated:

> "The challenge is that we rely solely on experience, information from social media, and each teacher's personal knowledge to determine the curriculum."

Third, the evaluation did not produce data that could be used longitudinally, so there is no documentation, history, or visualization of progress. Teachers 2, 3, and 6 stated:

> "There are currently no specific daily assessment tools to track the children's reading progress. If we had to assess them every day, it would be

very exhausting, so we rely solely on existing data or on assessments conducted with parents at times convenient for the teachers."

Technology Readiness Profile

In addition to the implementation challenges mentioned above, the researchers also explored teachers' psychological readiness for technology using the Technology Readiness Index (TRI) framework. TRI analysis (Adhitama et al., 2022). An analysis of the results of in-depth interviews with 6 teachers, supported by the results of a questionnaire administered to 19 teachers, identified four dimensions of technology readiness: optimism, innovativeness, discomfort, and insecurity.

First, the optimism dimension indicates that teachers have a positive attitude toward the use of technology in learning. Teachers believe that technology can improve the quality of learning, particularly by capturing students' attention, facilitating the delivery of material, and aiding the assessment process when supported by adequate facilities. Teachers 2, 5, and 6 stated:

"Actually, we'd like to use a website for our own daily evaluations, but so far there hasn't been a website we can use that's integrated with the school."

These findings are supported by questionnaire results showing that most teachers have utilized digital media such as interactive PowerPoint presentations, educational videos, Canva, Wordwall, and Quizizz in their teaching and learning activities. The majority of teachers also believe that digital media effectively enhances students' understanding and hope that more interactive and user-friendly learning resources will be available in elementary schools.

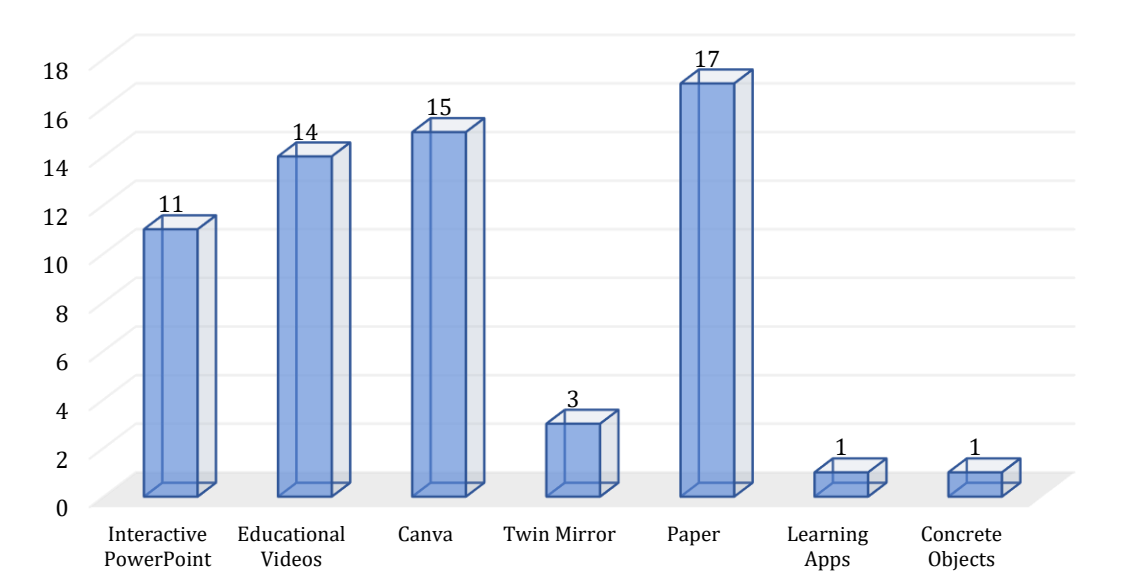


Fig. 2. Types of media commonly used

Second, the "innovativeness" dimension indicates that teachers are open to the use of technology, but its implementation is still tailored to the classroom learning context. Teachers do not view technology as a substitute for conventional learning, but rather as a

complement that is integrated with hands-on learning activities. Teachers 4, 5, and 6 explained:

> "We look for resources online to keep all the kids active on the field. The method can't be completely digital since there still has to be a certain amount of offline work as well, so it involves a combination of digital and face-to-face activities as required".

The results of the questionnaire indicate a similar trend: most teachers favour a method of teaching which involves combining digital media with traditional activities and makes use of a range of educational apps to support the learning process. These findings indicate that teachers' innovations are more often realized through adapting media to students' needs rather than through the full implementation of technology.

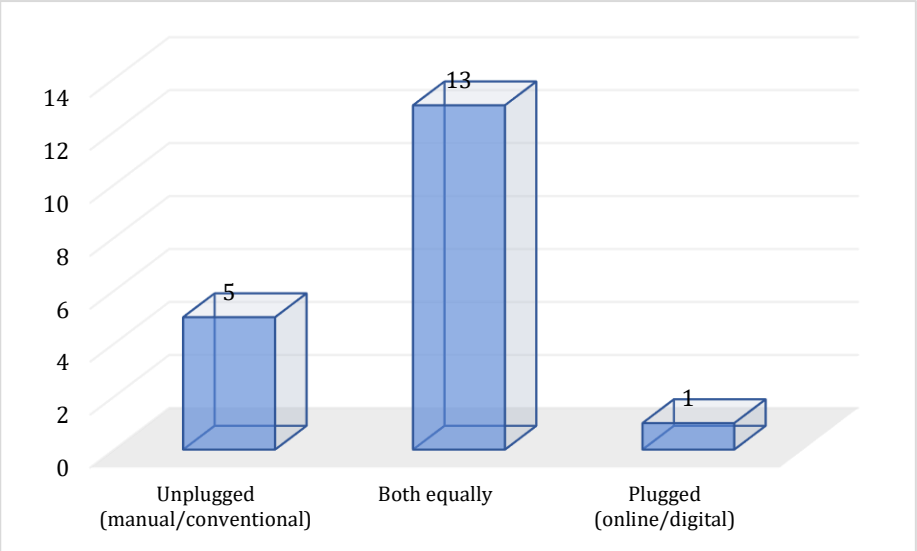


Fig. 3. Learning approach

Third, the dimension of discomfort is reflected in the various obstacles teachers still face in implementing technology. These obstacles are not caused by a rejection of technology, but by the complexity of using the system, limited facilities, and an increased workload in lesson preparation. Teacher 2 stated:

> "Digital technology is very beneficial for us, but we don't always have to use it for everything it depends on our needs. Take the e-report card system, for example: you have to go through an operator to access it, so it's a bit difficult to use it on your own to fill out assessments. We'd prefer it if the technology were easier to use."

These findings are supported by the results of a questionnaire, which indicate that the main barriers to technology use include limited access to devices, unreliable internet access, and the time required to prepare digital learning materials.

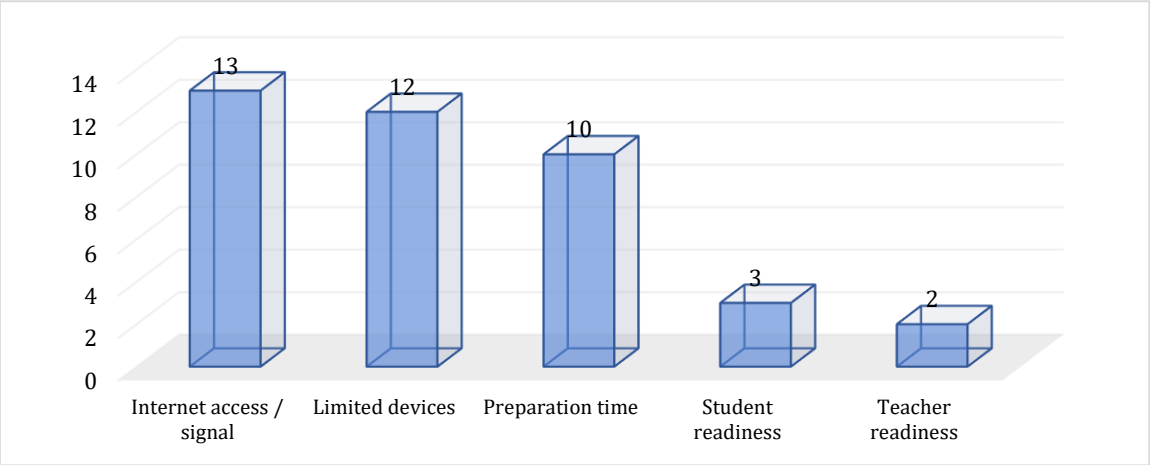


Fig. 4. Barriers to the use of digital learning media

Fourthly, the aspect of insecurity shows that teachers are careful when it comes to introducing technology into the learning process. This caution is mainly due to students' readiness, the availability of devices, and the need for guidance in the use of technology. As Teacher 2 said:

> "I too would like to see guidelines established regarding children's use of technology, since I am worried that there are no restrictions at all. The technology should definitely be simple in order that it may be used easily by everyone. Moreover, as we are all of different ages, anxiety will certainly arise if an error occurs, the internet fails, or if the parents cannot access it."

The questionnaire results support the idea that there is still no complete uniformity in teachers' readiness to use technology in schools. It has been pointed out by some teachers that students' readiness to use technology continues to vary. This indicates that the success of implementing technology depends not just on the systems that are developed but also on the readiness of the people who will be using them.

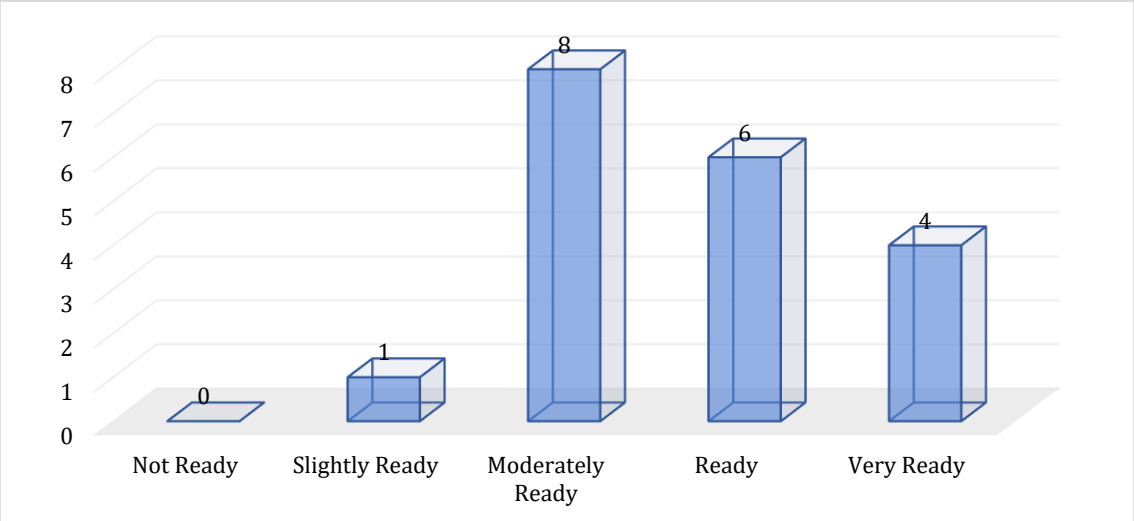


Fig. 5. Students readiness to use technology

Overall, the findings indicate that teachers are ready to adopt learning technologies, but their implementation is influenced by infrastructure readiness, student characteristics, and the system's ease of use. The BACA+ platform was designed on the basis of the four dimensions of the Technology Readiness Index framework and included a simple interface, consistent navigation, easily accessible content, and integrated student progress reporting in order to meet the needs of teachers in the area of differentiated instruction.

Comparative analysis of learning platforms

A comparison study showed the separate limitations of each platform. While Bookbot has the benefits of visual and audio features, it is receptive in character and therefore students mainly function as passive recipients of the information. *Budi* promotes active reading but has a less engaging visual interface and navigation which is not yet intuitive, causing a high level of dependence on teachers. *Merdeka Mengajar* is not appropriate for students in the early grades since both the content and the interface are too complicated for beginning readers. Neither of the three platforms combines skill mapping, adaptive content, interactive exercises, and progress monitoring in a unified manner, and this is the main gap that BACA+ resolves.

Table 3. Comparative Analysis of Learning Platforms

No	Aspect	***Bookbot***	***Budi***	***Merdeka Mengajar***
1	Main Purpose	Story-based reading	Reading practice	Teacher aid
2	Primary Users	Students	Students	Teacher
3	Visual Quality	Illustrative, engaging	Simple, less engaging	Information-packed
4	Student Engagement	High at the beginning	Moderate	Low
5	Suitability for Early Readers	Fairly suitable	Fairly suitable	Not suitable
6	Support for Differentiation	None	None	Partial (teachers only)
7	Integrated Monitoring	None	None	None
8	Main Limitations	Passive interaction	Non-intuitive navigation	Not designed for students

Ideate phase: The LANCAR strategy and platform concept

In the ideation phase the Crazy 8 method was used in order to quickly come up with a wide range of alternative ideas. This approach resulted in eight concept sketches, each of which depicted different possible features, learning pathways, and interaction mechanisms for the reading literacy platform. The analysis and synthesis of the results were carried out using the field findings and the user needs established in the earlier stage. As a result of this synthesis the LANCAR strategy was obtained, the strategy comprising six main elements: Level, Assessment, Navigation, Content, Activity, and Reporting. This strategy acts as a conceptual framework by connecting user needs, learning theory and platform feature design. (Hoadley & Campos, 2022).

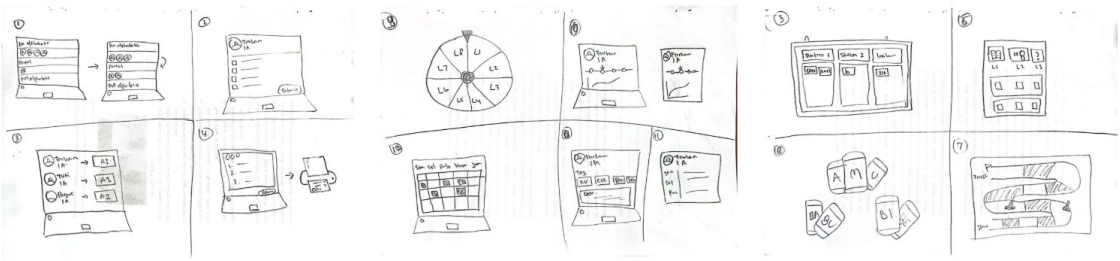


Fig. 6. Crazy eight

The LANCAR strategy was developed based on the principles of differentiated instruction (Tomlinson, 2017), the stages of reading theory (Ehri, 2014), multimedia learning (Mayer, 2020), and cognitive load theory (Clark & Kimmons, 2023). These six components are translated into a system structure that supports the assessment of reading skills, the provision of adaptive materials, interactive learning activities, and the continuous monitoring of student progress. User flows were developed according to the LANCAR strategy for two kinds of users: teachers and students. The user flow for teachers includes entering student data, carrying out initial assessments, grouping the students according to their reading level, choosing materials suitable for each level, carrying out learning activities, recording the learning outcomes, and monitoring students' progress. On the other hand, the user flow for students is simpler and consists of entering a learning level, accessing visual and audio materials, completing interactive exercises, receiving feedback, and seeing their learning progress.

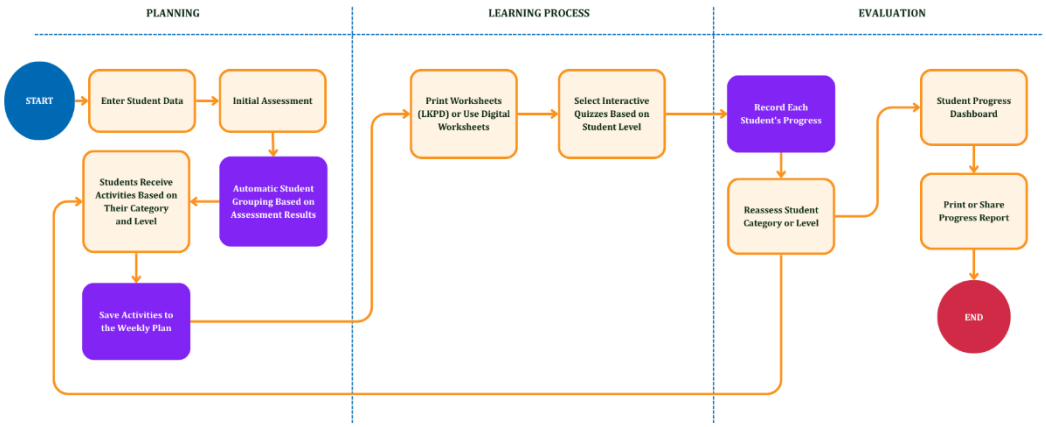


Fig. 7. Platform usage flowchart

The user flow was created with the aim of making sure that each element of the LANCAR strategy is systematically carried out in the user experience, and this user flow then forms the basis on which to develop the information architecture, the system architecture, and the platform prototype in the following phase.

Prototyping phase: Platform design

The prototype was created using the LANCAR user flow strategy and included two main, interconnected interfaces: one for teachers and one for students. The features available to teachers were as follows: (1) the Main Dashboard, which acts as a centre for

classroom information by showing the number of students in each reading category and offering quick access; (2) Reading Level Management, which consists of dividing students into the four levels established by Ehri (2014); (3) Material Management, which supplies adaptive materials for each level; (4) Progress Monitoring, which presents progress data in the form of progress bars, graphs, and colour indicators to aid data-driven decision-making; and (5) Learning Evaluation, which is used to assess learning outcomes so that future planning can be based on them (Ehri, 2014). The teacher platform is shown in the image below:

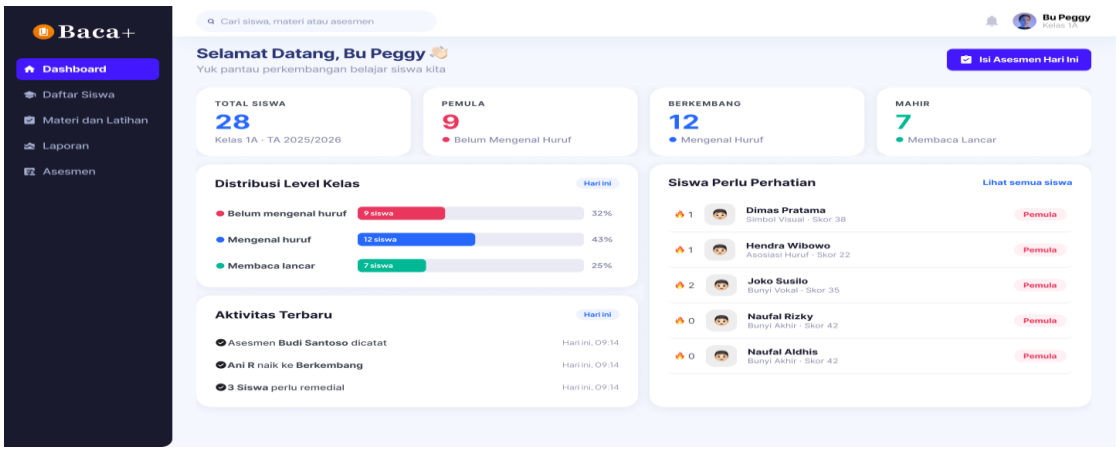


Fig. 8. Teacher's main dashboard

The Teacher's Main Dashboard acts as a central point for learning information. It gives an overview of the number of students according to their reading proficiency and their progress in learning, together with easy access to the main features. The way the information is presented enables teachers to immediately see the situation in their class without having to compile the data manually. This feature is intended to aid data-driven decision-making in order to decide on suitable learning strategies.

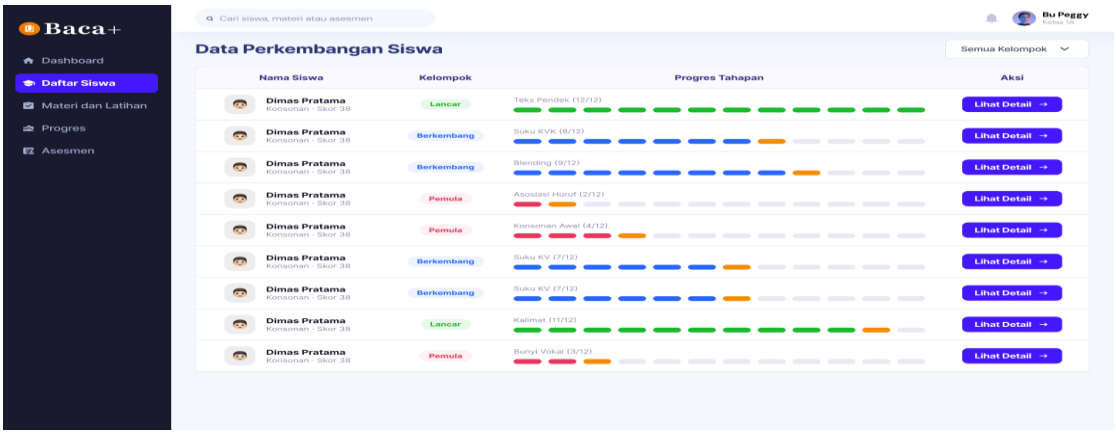


Fig. 9. Reading stage management

Teachers are able to divide their students into four reading stages using the Reading Stage Management feature, the stages being those proposed by Ehri (2014): pre-alphabetic, partial alphabetic, full alphabetic, and consolidated alphabetic. The system uses this

grouping to offer learning materials that are suitable to each student's ability level (Ehri, 2014).

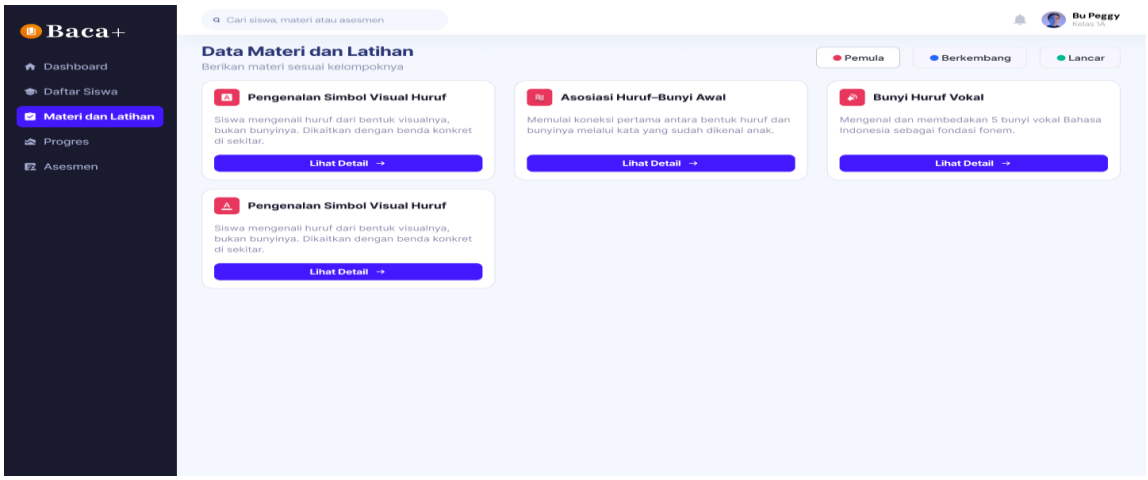


Fig. 10. Reading stage management

The feature known as Learning Materials Management lets teachers handle and distribute adaptive learning materials which have been tailored to the characteristics of each group, thus allowing for a more systematic method of carrying out differentiated instruction.

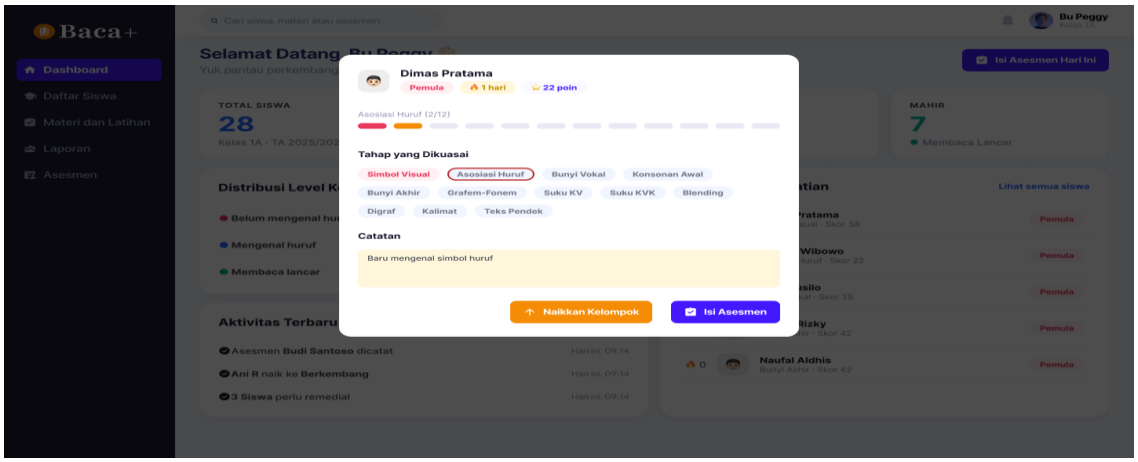


Fig. 11. Student progress

The Progress Monitoring feature shows students' progress in a visual way using progress bars, graphs, and colour-coding, so that teachers can keep a continuous watch on each student's learning achievements.

Learning Assessment is employed to record students' learning outcomes and to aid in the planning of further learning activities. By combining these two functions, teachers are able to monitor students' progress over time and promote communication with parents regarding their children's advancement.

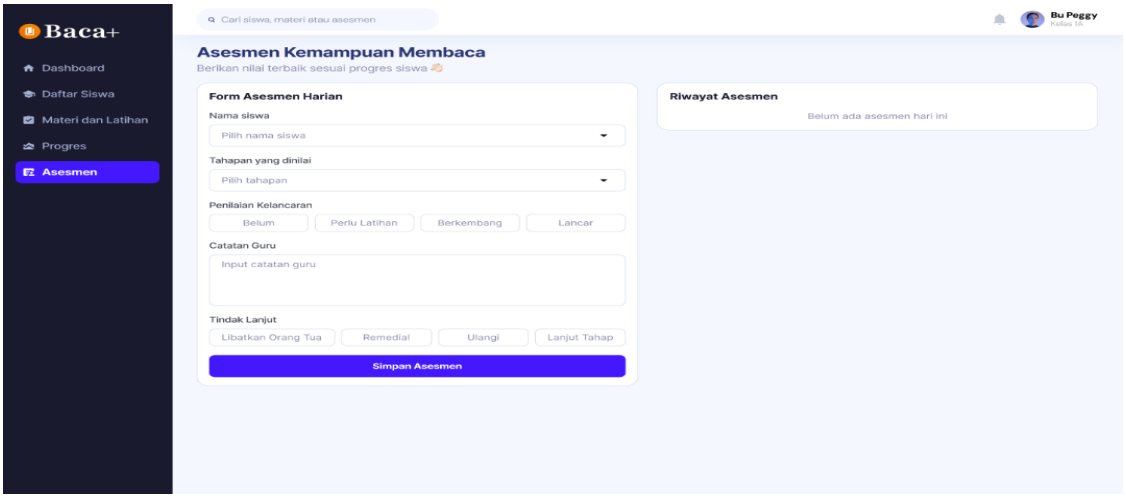
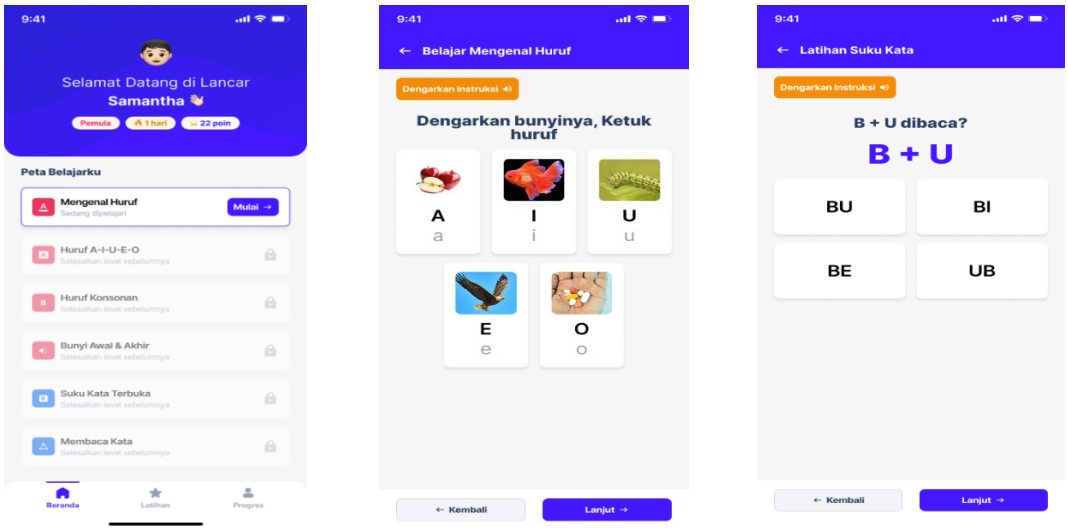


Fig. 12. Learning assessment

The student platform offers several features: (1) Interactive Reading Materials, which use graded content with text, illustrations, and audio based on multimedia learning principles; (2) Learning Audio to help with pronunciation during self-study; (3) Reading Exercises that provide repeated interactive practice; (4) Immediate Feedback, where the system responds to student actions; and (5) Learning Progress, which shows students how much they have achieved. You can see the platform's design in the Figure 13.

The interface for students is intended to provide a reading experience which is suited to each student's ability level, and the prototype uses the principles of multimedia learning by combining text, illustrations, audio, and interactive activities in order to make the learning process more engaging, easier to understand, and suitable for independent learning.

The main interface that the students use throughout the learning process is shown in Figure 13. Figure 13(a) is the Homepage, which acts as the principal page giving access to all the learning activities. It has a simple layout and uses easily identifiable icons so that the students can move between the different features on their own. Figure 13(b) presents the interactive reading materials, these being arranged according to the students' reading proficiency levels. By combining text, illustrations, and audio, the materials offer the students a more engaging learning experience and assist them in understanding the relationship between letters, sounds, and meanings in line with the principles of multimedia learning. Figure 13(c) shows the reading exercises, which have been created as interactive activities to reinforce the students' understanding of the material they have studied. The exercises are arranged in stages according to the students' reading ability levels so that they can learn at their own speed. Figure 13(d) describes the Instant feedback feature, which gives automatic responses to the students' work. After completing an activity, feedback is given immediately, enabling the students to see their mistakes and successes right away and thus encouraging continuous learning. Figure 13(e) shows the learning progress feature, which illustrates the students' learning development through visual indicators. This feature enables the students to keep track of their learning achievements, increases their motivation to finish each learning stage, and provides progress data that teachers can monitor.



(a) Homepage (b) Learning Content (c)Reading Exercises

(d)Feedback (d) Learning Progress

Fig. 13. Student features interface

The student interface is constructed with the aim of offering a more adaptive, interactive, and personalized reading learning experience, one that is suited to each student's ability level. By incorporating tiered content, interactive exercises, immediate feedback, and the ability to visualize progress, it allows students to learn on their own while at the same time giving teachers valuable insights into students' progress that can be used for differentiated instruction.

Expert validation stage

Expert validation was conducted by two validators, each focusing on different aspects of the assessment based on their areas of expertise. The domain expert assessed the alignment with learning objectives, the accuracy of reading level mapping, support for

differentiated instruction, the quality of the materials, and the platform's support for teachers' tasks. The media expert assessed usability, visual design, interaction design, and user experience. The assessment was conducted using a five-point Likert scale, with the results presented in Table 4.

Table 4. Expert validation results

No	Validator	Assessment Aspect	Average	Interpretation
1	Domain Expert	Alignment of Learning Objectives	5.00	Strongly Agree
2	Domain Expert	Reading Stage	4.00	Agree
3	Domain Expert	Differentiated Instruction	4.00	Agree
4	Domain Expert	Quality of Instructional Materials	5.00	Strongly Agree
5	Domain Expert	Support for Teachers	5.00	Strongly Agree
	Domain Expert	Average	4.82	Strongly Agree
6	Media Expert	Usability	4.75	Strongly Agree
7	Media Expert	Visual Design	5.00	Strongly Agree
8	Media Expert	Interaction Design	4.75	Strongly Agree
9	Media Expert	User Experience	5.00	Strongly Agree
	Media Expert	Average	4.88	Strongly Agree

The results of the domain expert validation showed an average score of 4.82, with the highest scores in the areas of alignment with learning objectives, quality of materials, and support for teachers (average of 5.00). The validators assessed that:

> "The website helps teachers identify students' reading skills,design differentiated instruction, and monitor learning progress more systematically."

Meanwhile, the reading and differentiated learning components received a slightly lower average score (4.00), with recommendations to add more variety to interactive learning activities and improve the learning progress reporting features. The results of the expert panel validation showed an average score of 4.88, with the highest scores in the areas of visual design and user experience (average 5.00), indicating that the layout, typography, colors, and visual elements were deemed consistent and conducive to a comfortable user experience. The usability and interaction design aspects received an average score of 4.75, with recommendations to develop personalized learning features and add interactive media. Overall, the validation results from both experts indicate that the BACA+ platform prototype was rated as suitable to highly suitable in terms of both concept and educational relevance, as well as design and user experience, making it suitable to proceed to the testing phase with teachers and students.

Test phase: Prototype evaluation results

Teacher test results

The evaluation of the prototype included 13 of the 19 teachers who were willing and capable of attending the prototype testing session, their teaching experience ranging from (1 teacher having less than 2 years, 3 having between 2 and 5 years, 3 having between 5 and 10 years, and 6 having more than 10 years). Each of the participants was asked to use the

platform's main features before judging the design's suitability on a 1-to-7-point Semantic Differential scale. The results of this evaluation are given in Table 5.

Table 5. Prototype evaluation results

No	Indicator	Average	Interpretation
1	Suitability to students' reading levels	6.65	Very Appropriate
2	Differentiation of learning content	6.64	Very Appropriate
3	Differentiation of learning processes	6.59	Very Appropriate
4	Differentiation of learning products	6.79	Very Appropriate
5	Usability and website design	6.62	Very Appropriate

For all the indicators the scores fell within the "very appropriate" category, the average lying between 6.59 and 6.79. This shows that the prototype was considered to be able to meet the needs of teachers when carrying out differentiated instruction. The highest score was achieved in the area of learning product differentiation (with an average of 6.79), which means that the teachers regarded the evaluation, documentation of learning outcomes, and the monitoring of progress as adequate for helping to develop follow-up learning activities tailored to students' needs. This result directly tackles the gaps identified in the classroom observation phase (Table 2), since earlier on differentiation of learning products had been carried out manually without any long-term documentation. The high score in this respect shows that the platform has successfully dealt with the most important weakness found in the initial situation.

On the other hand, process differentiation achieved the lowest average score of the four types of differentiation (6.59), yet it still fell within the "very appropriate" range. This is in agreement with Tomlinson (2017), who notes that process differentiation—meaning adapting learning methods and activities to suit students' learning styles—is more difficult to standardise in a digital system than content or product differentiation, since it relies on situational, direct interactions between teachers and students. At the same time, the usability and website design indicators also received high scores (6.62 on average), showing that the interface is easy for teachers to understand and use. This is in line with the results of the Technology Readiness Index at the Empathize stage (TRI Table), which indicate that teachers generally tend to avoid complicated systems; the simple design of BACA+ seems to directly meet this preference. User acceptance of the platform is presented in Table 6.

All the indicators obtained an average mark that was above 4.50 out of 5; the highest score (which was 4.77 on average) indicates that there is a high level of user acceptance of the platform in question. This top score (an average of 4.77) was secured by four indicators: the ease of implementing differentiated instruction, the assistance given with student grouping, the ease of monitoring student progress, and the degree of alignment with the *Kurikulum Merdeka*. The results show that the platform is regarded as able to address the key needs of teachers identified earlier in the needs analysis phase, particularly with regard to grouping students according to their reading ability, monitoring learning progress, and carrying out differentiated instruction in a more structured manner.

The findings of this study reinforce the importance of integrating adaptive learning and differentiated instruction into one learning ecosystem. Consistent with the results of a systematic literature review by Sari et al. (2026), research on adaptive learning and

differentiated instruction is still largely conducted separately; therefore, an approach capable of integrating these two concepts into a single learning platform is needed (Sari et al., 2026). These findings also differ from the results of a comparative study of Bookbot, BUDI, and *Merdeka Mengajar* (Table 3), which showed that none of these platforms integrated learning monitoring with differentiated instruction simultaneously; thus, the high score for BACA+ indicates that this platform fills a gap not yet addressed by the comparison platforms. The LANCAR strategy was developed to address this need through the integration of reading proficiency assessment, adaptive content, learning activities, and continuous monitoring of student progress.

Table 6. Platform acceptance results

No	Indicator	Average	Interpretation
1	Helps plan reading instruction more systematically	4.69	Very Appropriate
2	Facilitates the implementation of differentiated learning	4.77	Very Appropriate
3	Helps with student grouping	4.77	Very Appropriate
4	Activities tailored to students' needs	4.69	Very Appropriate
5	Facilitates monitoring of student progress	4.77	Very Appropriate
6	Helps understand student progress	4.62	Very Appropriate
7	Facilitates documentation of learning outcomes	4.62	Very Appropriate
8	Realistic for use in the classroom	4.54	Very Appropriate
9	Aligned with the *Kurikulum Merdeka*	4.77	Very Appropriate
10	Interested in using it if further developed	4.69	Very Appropriate
11	Willing to recommend it to other teachers	4.62	Very Appropriate

Teachers' qualitative feedback focused more on feature development such as the addition of a resource search function, digital worksheets, and a question bank than on changes to the platform's underlying concepts. These findings indicate that the feedback provided centered on refining implementation, while the core concepts of the LANCAR strategy were positively received by the participants.

Student test results

The usability test was carried out with 15 students from elementary school who used the BACA+ platform as end users. During the test, the students were observed as they carried out various task scenarios making use of the platform's main features. The results of the test indicated that most of the activities could be completed either on their own or with only a little help, the task success rate being 98.3%.

Table 7. Summary of test results

No	Indicator	Value
1	Number of Participants	15 students
2	Number of Activities Tested	12 activities
3	Total Testing Tasks	180 tasks
4	Successful Without Assistance	132 tasks (73.3%)
5	Successful With Minimal Assistance	45 tasks (25.0%)
6	Failed	3 tasks (1.7%)
7	Task Success Rate	98,3%

Based on Table 7, out of a total of 180 tasks assigned to 15 students, 177 tasks (98.3%) were completed, either independently or with minimal assistance. Most activities (73.3%) were completed independently, while 25.0% of the activities required minimal assistance in the form of guidance in reading instructions or identifying button functions. Only 1.7% of the activities were not completed. This pattern aligns with Ehri's (2014) reading stage theory, which forms the foundation of the LANCAR strategy: Students at the pre-alphabetic and partial alphabetic stages who, by definition, have not yet fully mastered the letter-sound relationship naturally require greater assistance with text-based tasks (reading materials, exercises) compared to audio-visual tasks (playing audio, viewing illustrations), because text-based tasks demand a decoding process they have not yet mastered. These findings indicate that the difficulties encountered are not caused by weaknesses in the interface design but are rather a natural consequence of the diversity in participants' reading stages a finding that actually validates the need for differentiation, which forms the basis of the platform's design.

These findings align with the principles of interaction design, which emphasize that interfaces for elementary school-aged children should prioritize consistent navigation, a simple layout, and ease of task completion to suit the users' characteristics (Sharp et al., 2023). Furthermore, the platform's use of a combination of text, illustrations, and audio supports the principle of multimedia learning, which states that presenting information through various representations can enhance the learning process when designed in an integrated manner (Mayer, 2020). The 98.3% task success rate achieved by BACA+ is also comparable to the results of similar research on the development of early reading media for first-grade elementary school students, in which Rosa et al. (2023) reported a practicality score of 4.76 (classified as "very practical") and an improvement in learning outcomes from a pretest average of 61.16 to a posttest average of 90.66 using a similar interactive medium, which strengthens the external validity of these findings even though the study was conducted in a different school context(Rosa et al., 2023).

CONCLUSION

This study successfully developed the BACA+ platform, a web-based, differentiated reading literacy learning tool, using a design thinking approach within the framework of design research. Field findings at SDN 028 Gumuruh indicate that the challenges in reading literacy are systemic in nature: differentiation of content, process, and products has not yet been integrated; evaluation is still conducted manually; and teachers need digital tools that are easy to use. The needs were met by means of the LANCAR strategy (Level, Assessment, Navigation, Content, Activity, and Reporting), this strategy combining reading proficiency mapping, assessment, adaptive content, interactive activities, and monitoring of student progress into one platform.

The results of the validation and evaluation indicate that the prototype was given very positive ratings, covering expert validation, the assessment of design suitability by teachers, user acceptance, and a student usage success rate of 98.3%. These findings suggest that the LANCAR strategy and the BACA+ platform have the potential to help promote a more systematic approach to differentiated reading instruction in elementary schools. This study is still limited to the prototype design and evaluation phase at a single school; therefore, further research is recommended to test the platform's effectiveness through a quasi-

experimental design and to expand its implementation to schools with more diverse characteristics.

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