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Android App to Measure Linguistic Intelligence of Elementary Students

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ABSTRACT

The critical period of language development is believed to occur from early childhood to puberty, with significant progress in grammatical comprehension and vocabulary use observed around the ages of six to nine. During this stage, schools play an essential role in fostering students' linguistic intelligence, which encompasses speaking, reading, listening, and writing skills. To support teachers in conducting systematic assessments, this study developed the Linguistic Intelligence Assessment Android (LIAA) application. The application was built using the Agile methodology with the Scrum framework, involving iterative sprints and teacher feedback. Blackbox testing confirmed that all core features, including student management, automated testing, and reporting, functioned as expected. Usability testing with 10 elementary school teachers produced high average scores for ease of use (4.4), display (4.1), access speed (4.4), and satisfaction (4.5). These findings indicate that LIAA is a practical and effective tool for enhancing the efficiency and objectivity of linguistic intelligence assessment in primary education.

1. INTRODUCTION

Language skills play an important role in the intellectual development of primary school students. Language is the main tool for thinking, communicating, and developing creativity. At the age of seven to nine, for example grades one to three, children's linguistic development shows significant progress, especially in understanding sentence structure and the use of complex vocabulary. According (Wahyuni, 2016), the critical period of language development occurs between the age of two and puberty, where at the age of six children still rarely use passive words and conditional sentences. The understanding of language rules continues to develop until and even after the age of nine. Therefore, formal education institutions need to pay special attention to developing linguistic intelligence in students from an early age.

Linguistic intelligence, as described by Gardner in his theory of Multiple Intelligences, refers to a person's ability to use language to express thoughts, understand others, read, and write (Gardner, 2006). These skills not only serve for daily communication needs, but also impact the development of students' critical and academic thinking. Previous studies have demonstrated that mobile applications can enhance students' linguistic skills, yet there is still no tool focusing specifically on structured linguistic intelligence assessment in primary schools. (Fadhli et al., 2020; Salamah et al., 2023; Sutarso Setyaningsih et al., 2022). In today's digital era, the utilization of mobile-based technology is an effective alternative to support the educational process (Husnita et al., 2023; Sari et al., 2020). Android-based applications can be an innovative solution for measuring and monitoring the development of students' linguistic intelligence in real-time and efficiently (Eliza et al., 2024; Rahmah & Juhriah, 2022; Wang et al., 2024). Research by (Perdana et al., 2022) shows that the use of mobile applications in a primary education environment can improve student engagement and learning outcomes.

However, there is currently no application available that specifically assists teachers in systematically measuring the linguistic intelligence of elementary school students. Therefore, this research aims to develop an Android Application for Measuring Linguistic Intelligence of Elementary Students. This application is named LIAA (Linguistic Intelligence Assessment Android) and is designed to help teachers in the assessment process more quickly, objectively, and accurately. This study adopts Gardner's Multiple Intelligence theory, focusing on linguistic intelligence measured through four indicators: speaking, reading, listening, and writing. These indicators serve as the basis for feature design and application assessment. In addition, this research aims to increase the effectiveness and efficiency of the linguistic intelligence assessment process, so that the measurement results become faster, objective, and accurate in supporting the learning process in elementary schools (Darmuki, 2020; Munasiah, 2021; Patriamurti et al., 2024).

2. METHODOLOGY

This research uses the Agile approach in the application development process, specifically the Scrum framework. Agile is a software development method that focuses on speed, collaboration, and flexibility, and allows for rapid iteration based on user feedback (Alsaqqa et al., 2020; Waja et al., 2021). This approach was chosen because it fits the characteristics of an Android-based mobile application development project that is adaptive and user-oriented (Esakia & McCrickard, 2016; Llema & Vilela-Malabanan, 2019). All stages of the research are described in the following subsections in sequence according to the principles of the Agile cycle, starting from planning, development, testing, and collecting user feedback.

Agile Development Cycle

The development process is divided into sprints, which are short, measurable work cycles that result in a working increment. Each sprint consists of the following stages: (1) Sprint Planning, (2) Design and Development, (3) Testing, (4) Review & Feedback. The development flow model is shown in Figure 1 below:

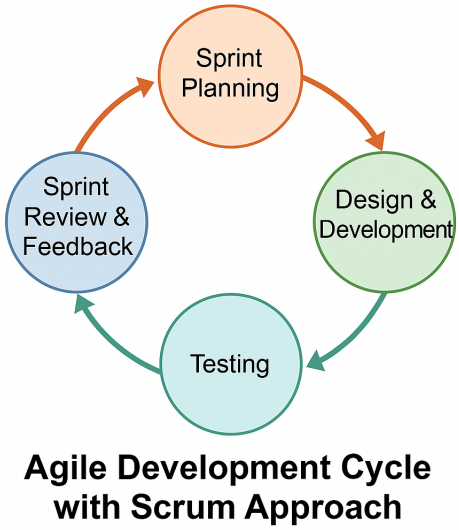

Figure 1. Agile Development Cycle with Scrum Approach

This approach allows developers to dynamically adjust the product based on user feedback at the end of each sprint. In the context of this research, the application of agile helped focus development on the essential features that teachers as the main users needed most.

Sprint Planning

The sprint planning stage was carried out by compiling a list of application features (product backlog) based on the results of interviews with ten teachers of Muhammadiyah 3 Pekanbaru Elementary School. This interview aims to identify functional requirements such as teacher account registration, student input, linguistic intelligence testing (speaking, reading, listening, writing), and recap of assessment results. Respondents were 10 teachers from Muhammadiyah 3 Pekanbaru Elementary School, selected purposively. Inclusion criteria included: (1) minimum of one year teaching experience, (2) currently teaching Indonesian language subjects at elementary level, and (3) willingness to participate in interviews and usability testing. This ensured that participants had sufficient pedagogical background and direct experience in evaluating students' linguistic competencies.

Sprint Execution

Application development was conducted using Android Studio as the development environment, with the Java programming language, and Firebase as the backend for data storage and authentication. Features were developed in two main sprints:

- Sprint 1: Interface design, account registration, class, and student management.
- Sprint 2: Student testing module, automated scoring system, and result report.

In the system design process, the Unified Modeling Language (UML) approach is used to visually describe the structure and workflow of the system. UML was chosen because it is a commonly used standard in software development to ensure clear and structured system documentation (Esiefarienrhe & Moemi, 2024). Here are some of the main diagrams used in designing the LIAA application. Use case diagrams describe the interaction between actors (in this case teachers) and the LIAA application system. This diagram shows the main functions that can be performed by users, such as logging in, managing student data, running linguistic intelligence tests, and viewing test results. These use cases help in understanding the needs of the system from the perspective of the end user.

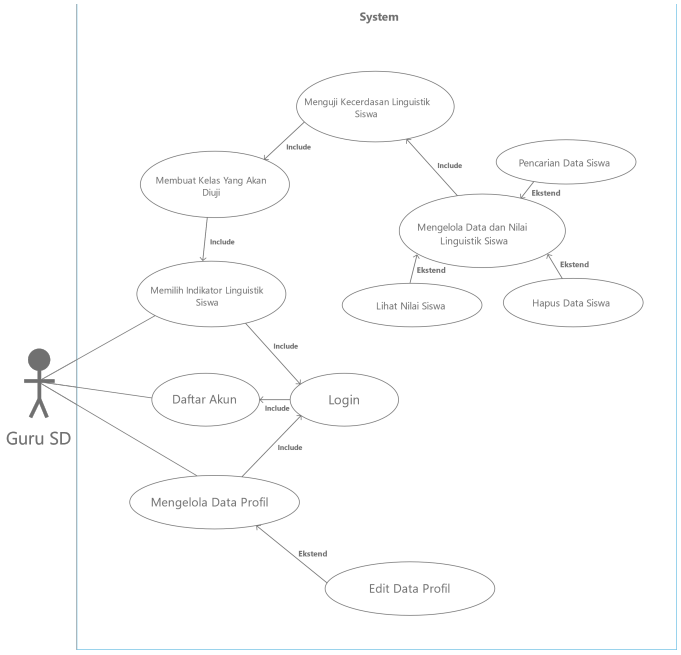

Figure 2. LIAA Application Use Case Diagram

Class diagrams are used to model the data structure in the application, including entities such as Users, Students, Questions, and Test Results. Relationships between classes are shown in the form of

association, aggregation, and generalization. This diagram forms the basis for developing the database structure and object-oriented programming in the application.

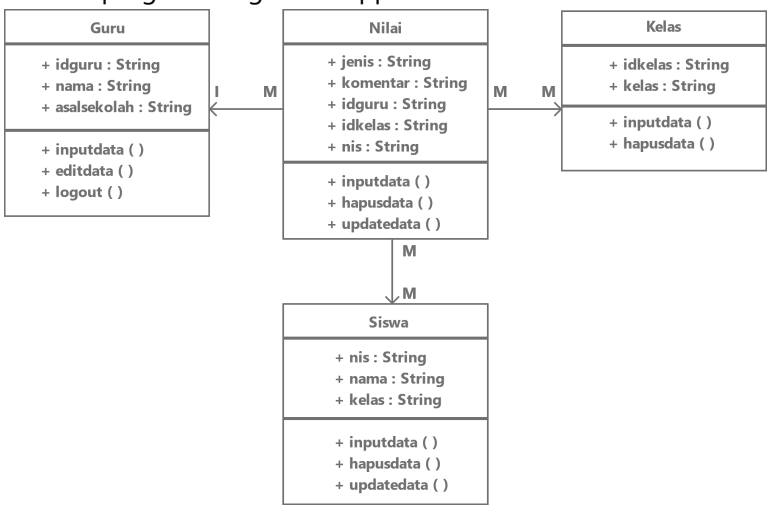

Figure 3. LIAA Application Class Diagram

The login page activity diagram shows the flow of activities carried out when a user logs into the system. This diagram includes username and password input, data validation process by the system, to successful or failed login status. This process is designed to be simple and efficient for users who are not familiar with technology.

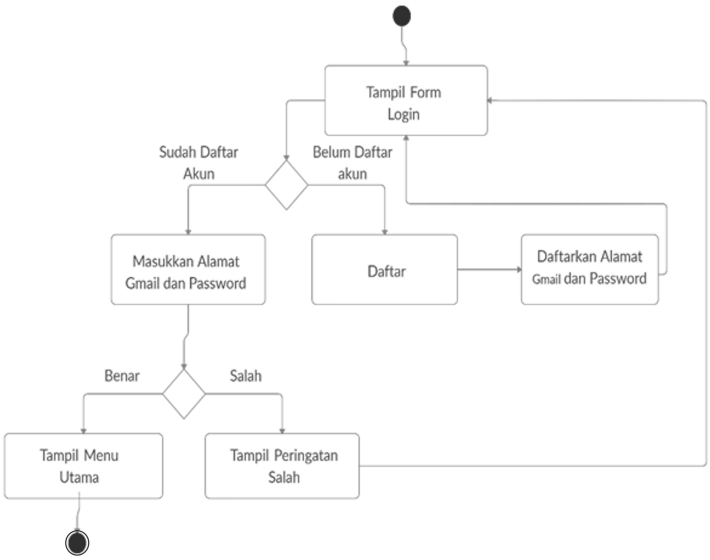

Figure 4. Login Page Activity Diagram

Linguistic Intelligence Testing Activity Diagram. This activity diagram illustrates the steps in the process of students working on linguistic intelligence questions through the application. The process starts from student selection, calling questions based on categories, inputting answers, to storing results and automatic scoring by the system. This diagram explains the logical flow of user interaction with the main features of the application.

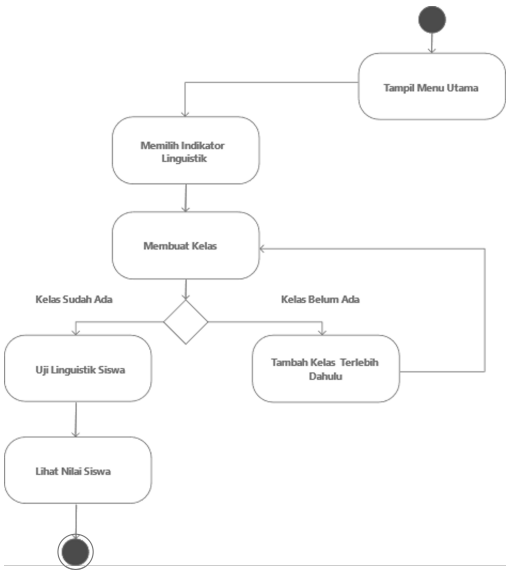

Figure 5. Linguistic Intelligence Testing Activity Diagram

Testing

Application testing included two methods: Blackbox testing to validate application functions, and usability testing with a simple questionnaire based on a 1-5 Likert scale. Usability testing was conducted on ten teachers at SD Muhammadiyah 3 Pekanbaru. The aspects assessed included ease of use, clarity of display, speed of access, and general satisfaction.

Sprint Review and Feedback

After the testing was completed, the usability testing results were collected and analyzed. Feedback from teachers showed satisfaction with the basic functionality of the app, as well as suggesting some additional features such as graphical summary of student grades, and integration with broader learning platforms. However, due to time constraints, the feedback has not been implemented directly in the redevelopment cycle, and will be part of the recommendations for the next stage of app development. This approach is in line with Agile principles that allow for changing priorities and continuous development based on user feedback (Balaban & Đurašković, 2021; Prisca Amajuoyi et al., 2024).

Summary of Sprint Stages

The following Table 1 summarizes the sprint stages and development outputs:

Table 1. Summary of Sprint Stages and Development Outputs

Main Activity	Output
UI design, teacher account, class/student management	Initial display, teacher, and student input forms
Linguistic test, automatic score system, result report	Question module, score calculation, result recap
Blackbox test, usability survey	Test results, further development suggestions

In Table 1 shows the practical stages in the implementation of Scrum-based application development. Each sprint is designed to produce a version of the application that can be tested directly by users, focusing on clarity of function and ease of access. This process not only helps developers in functional validation, but also allows users to provide direct feedback on the features being developed.

3. RESULTS AND DISCUSSION

RESULTS

Feature Implementation Based on Sprint

The development of the LIAA (Linguistic Intelligence Assessment Android) application was conducted in two sprints. The first sprint focused on creating the interface and basic features, such as teacher registration, class, and student management. The second sprint continued with the main features, namely testing students' linguistic intelligence and automatically recapitulating the score results. After the two sprints were completed, the application successfully reached the minimum viable product (MVP) status, which is the initial version that can be directly used by users. Here are some interface views of the implementation results:

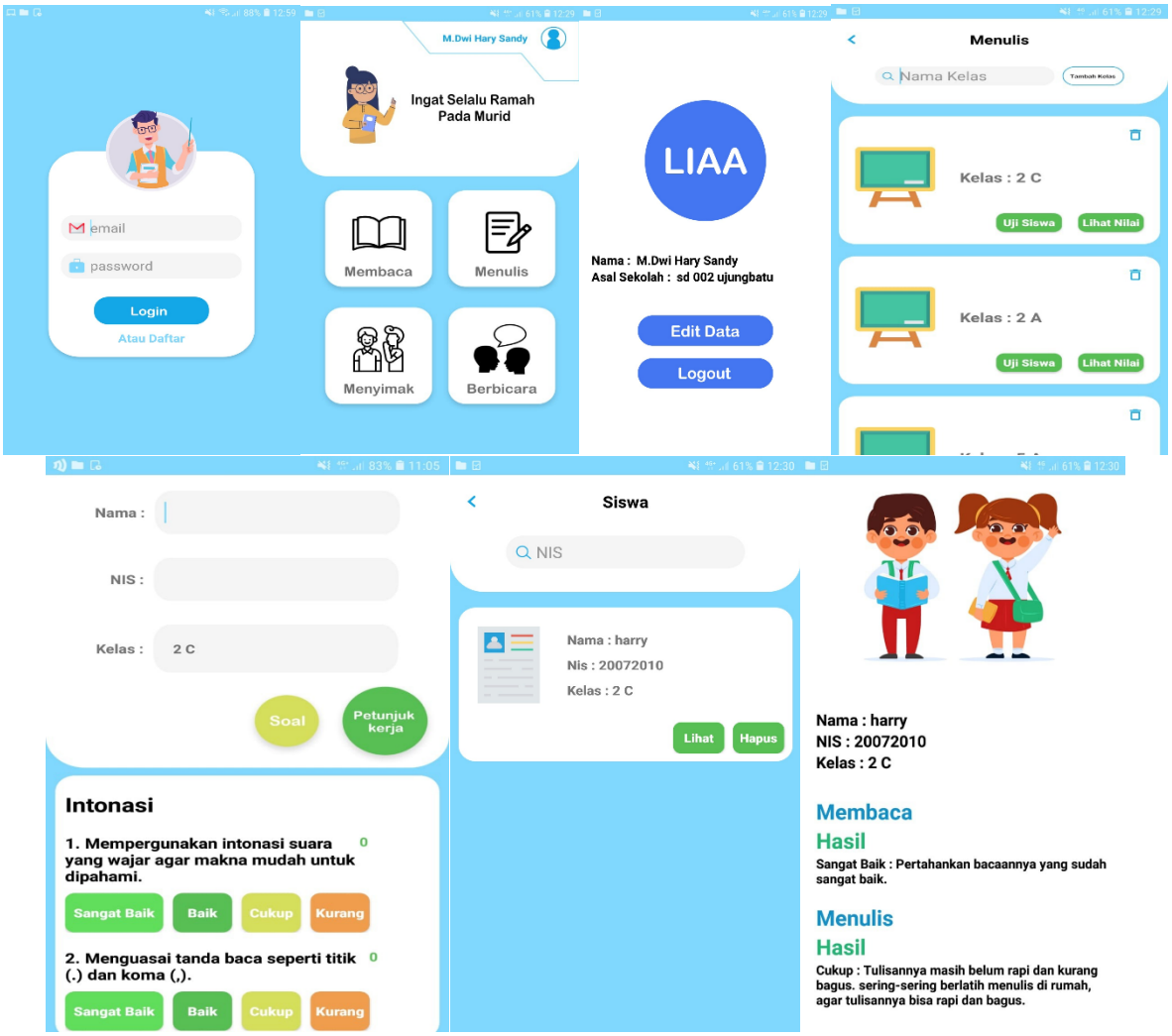

Figure 6. Application Interface

Blackbox Testing

After the implementation is complete, Blackbox testing is carried out to verify whether each main feature runs according to the designed specifications. The test results are shown in Table 2 below:

Table 2. Application Blackbox Testing Results

Tested Features	Input	Expected Output	Status
Teacher Registration	Valid data	Account successfully created	Successful
Login	Username & password	Login to dashboard	Successful
Add Class	Class name	Class saved	Successful
Input Student Data	Complete biodata	Data saved	Successful
Test Implementation	Question answers	Grades are calculated automatically	Successful
Grade Report	Selected students	Grade recap appears	Successful

All tests produced the expected output. No critical bugs or functional constraints were found during the testing process.

Usability Testing

To assess the level of comfort and ease of use of the application, usability testing was carried out with a 1-5 Likert scale questionnaire to 10 teachers. The aspects assessed included: (1) Ease of Use, (2) Display, (3) Access, (4) Satisfaction.

Table 3. Usability Testing Scores per Teacher

Teacher	Ease of Use	Display	Access	Satisfaction
Teacher 1	4	4	3	5
Teacher 2	5	5	5	5
Teacher 3	4	4	5	4
Teacher 4	4	3	4	4
Teacher 5	5	4	5	5
Teacher 6	4	4	4	4
Teacher 7	5	5	5	5
Teacher 8	4	3	4	4
Teacher 9	5	5	5	5
Teacher 10	4	4	4	4

From the table above, most teachers gave high scores (4 and 5) for all aspects. However, there are some scores of 3 on display and access, indicating that there is room for improvement in interface and technical efficiency.

Table 4. Usability Testing Score Average

Aspect	Average Score	Interpretation
Ease of Use	4,4	Very Good
Display	4,1	Good
Access	4,4	Very Good
Satisfaction	4,5	Very Good

The results showed that the application was very well received by users. The highest score was on the general satisfaction aspect, while the display scored good but could still be improved.

Discussion

Based on the test results, the LIAA application is proven to be able to meet the needs of teachers in assessing students' linguistic intelligence systematically and digitally. The Agile approach enabled a responsive development process and focused on prioritized features, such as testing and score recap. The high usability score supports the claim that this application is feasible to use in an elementary school setting. These findings are in line with research by (Sugiharto et al., 2023) which emphasized that simple interfaces and focused functions increase technology adoption by educators. In addition, (Cavalcanti et al., 2021) showed that a system that provides quick and automated feedback greatly assists teachers in the student assessment process. However, there are limitations in the scope of testing. The tests were conducted on a small scale and have not involved environments with extreme technical conditions. In addition, additional proposed features such as grade graphs, data export, and e-learning integration have not been implemented due to sprint time constraints. Suggestions for further development include multiplatform development and large-scale testing in several schools with different network infrastructures.

4. CONCLUSION

This research produces an Android-based Linguistic Intelligence Assessment Android (LIAA) application that can assist teachers in measuring the linguistic intelligence of elementary school students. Development using the Agile (Scrum) approach allows an iterative process that is responsive to user needs. The results of Blackbox testing show that all the main features of the application function according to specifications, while the results of usability testing provide high average scores on aspects of ease of use, clarity of appearance, speed of access, and general satisfaction. This application is expected to be an effective and efficient alternative evaluation tool in the primary education environment. Based on the test results and user feedback, future development of the application is recommended to add graphical analytic features, export of assessment results to Excel format, and integration with school e-learning platforms. In addition, the expansion of testing by involving a larger number of respondents and testing in various network conditions is also recommended to ensure the performance of the application more broadly. Future research can focus on improving the user interface and developing multiplatform versions of the application, including the iOS operating system.

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