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Agile approach to stunting data integration: an extreme programming perspective

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ABSTRACT
Child stunting is a global health problem requiring a holistic approach, including integrating health data for effective monitoring and analysis. This research was motivated by the need to develop a stunting data integration application responsive to change and meeting user needs. The extreme approach of Extreme Programming (XP) was the main focus of this endeavor due to its potential to improve team collaboration and software quality. The research involved three main stages: data collection, application development, and user needs analysis. The results showed that applying the XP approach effectively improved team collaboration, responsiveness to change, and software quality. Testing of application features and user acceptance evaluations reflected the application's success in meeting user expectations and needs, with satisfaction levels reaching 87 percent, according to stakeholder testing results. This research makes an essential contribution to stunting data integration application development. The XP approach proved its effectiveness in this context and opened the door for further research and development in the application of agile methods in the health sector.

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INTRODUCTION

Stunting is a condition of stunted growth due to chronic malnutrition, posing severe risks to children's health and development. This phenomenon touches on physical aspects and threatens intellectual potential and future productivity. A holistic understanding of stunting is crucial in prevention and treatment efforts. In this framework, data integration becomes a vital aspect. By involving various sources of child health data, including anthropometric data, medical history, and environmental factors, we can build a comprehensive picture of the condition of stunting and the factors that influence it(Sudigyo et al., 2023).

Despite its importance, the development of stunting data integration applications is not free from complex challenges. The diversity of data sources, dynamic changes in child health information, and the need for responsiveness to policy or protocol changes are some of the aspects that create complexity in the development of this application. These challenges prompt the need for a responsive and adaptive development approach to address the uncertainties and dynamics inherent in child health data(Bouaziz et al., 2019; Todorov et al., 2011).

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In this context, there is an urgency to explore an agile approach, where changes and adjustments can be made efficiently without compromising the quality and reliability of the application. Therefore, this research investigates the integration between the agile approach and the Extreme Programming (XP) perspective in developing a stunting data integration application(Al-Saqqa et al., 2020; Banka et al., n.d.; Mishra & Alzoubi, 2023; Robin, 2022; Singh et al., 2022; Wahyuni et al., 2023; Wahyuningrum et al., 2021; Wang et al., 2023). Thus, this research aims to contribute to developing an effective and responsive solution for stunting analysis, creating a solid foundation for the prevention and treatment of this condition in children.

We face two main challenges in software development: uncertainty and changing needs. Especially in stunting research, uncertainty arises due to the ever-changing dynamics in child health information. Evolving data over time creates an environment where data analysis must constantly evolve, requiring flexibility and adaptability in development approaches(Batliner et al., 2022; Beecham et al., 2021; Dewi & Irham, 2021; Dingsoeyr et al., 2019; Dingsøyr et al., 2012; Hasan et al., 2013; Santos et al., n.d.; Serrador & Pinto, 2015). The changing dynamics of child health information pose significant challenges. Information such as growth patterns, health history, and environmental factors can undergo sudden changes. Therefore, the development of stunting data integration applications must accommodate these changes quickly and effectively without compromising data integrity and accuracy.

The expansion of data analysis needs in stunting research further emphasizes the complexity of the development task. As the understanding of the factors that influence stunting grows, the need for more in-depth and holistic data analyses becomes more pressing. Therefore, an approach is needed that is not only able to handle changing needs but also efficiently extend functionality. In the face of this uncertainty and dynamism, an agile and responsive approach is becoming increasingly important. The paradigm shift in software development leads to the recognition that change is a certainty and not an exception. In this context, agile approaches have become a prominent solution(Leong et al., 2023; Sarhadi et al., 2022; Senabre Hidalgo, n.d.).

The advantage of an agile approach lies primarily in its ability to handle changing requirements more efficiently(Ahmed et al., 2023; Akhtar et al., n.d.; Hinderks et al., 2022; Martin, 2023). With an iterative and responsive development cycle, development teams can respond to changes quickly without compromising software quality. This creates an environment where the stunting data integration application can continue to evolve according to changes in child health information and the expansion of data analysis needs. Thus, the agile approach provides a strong foundation for adaptive and effective software development in stunting research.

In addition, continuous testing and iterative development are principles that strengthen responsiveness. Continuous testing allows changes or additional features to be quickly identified if they meet the desired quality standards. Iterative development allows for quick fixes and adjustments so that the result can more precisely match the needs and changes.

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This research aims to thoroughly analyze the effectiveness of agile approaches, focusing on applying XP methodology in developing a stunting application. The development process will follow XP principles, including paired development, continuous testing, and iterative development. Evaluation of its impact on successful data integration will be the main focus. This involves assessing the extent to which agile approaches, notably XP, can overcome the challenges of developing a stunting data integration application and improve the flexibility and quality of the final output.

METHODS

This research involves three integral stages to detail and develop a responsive stunting data integration application. The first stage involved data collection from multiple sources, including identifying and verifying anthropometric data, medical history, and relevant environmental factors. Next, the app development stage was conducted iteratively with close team collaboration, adopting an Extreme Programming (XP) approach to ensure testing continuity and structural improvements through code refactorization. Finally, user requirements analysis involved stakeholder identification, interviews, and observations to determine key features and development priorities, with prototype testing to ensure conformance to user expectations. As shown in Figure 1, the process provides a comprehensive, integrated approach to producing a stunting data integration application that is accurate and responsive to stakeholders' needs and expectations.

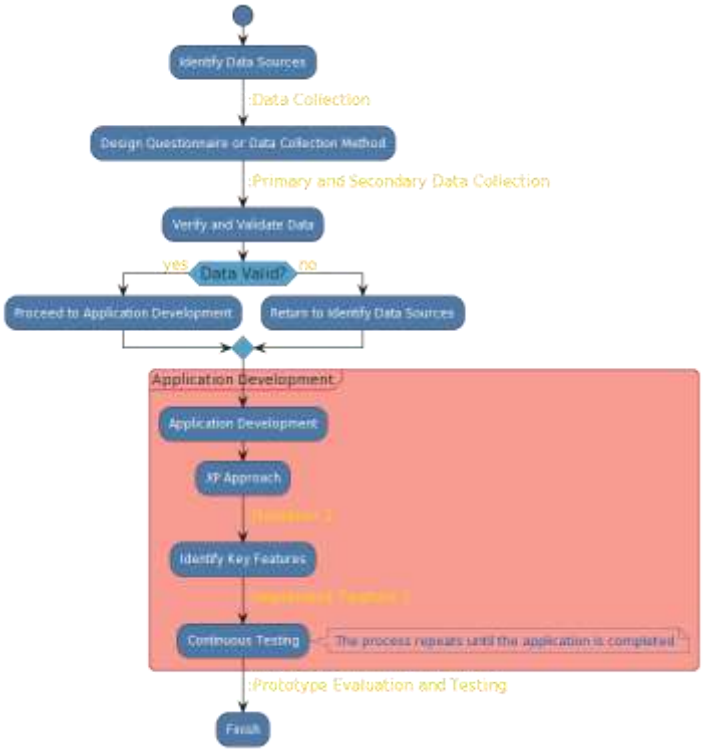

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Figure 1. Research Methods

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Data Collection

At this stage, the research begins by identifying relevant data sources, such as anthropometric data, medical history, and environmental factors. Appropriate questionnaire design and data collection methods are devised to obtain the required information. The data collection involves primary and secondary data, focusing on verification and validation to ensure data accuracy and credibility.

Application Development

The application development phase was conducted with an iterative approach and close team collaboration, adopting the Extreme Programming (XP) method. The team identified key features that needed to be developed in each iteration and conducted continuous testing to ensure software quality. Periodic refactorings of the code were performed to improve code cleanliness and structure.

User Needs Analysis

The final step involved stakeholder identification, interviews, and observations to understand user needs and expectations. Analysis of critical features and prioritization based on user feedback form the basis for application development. Prototype testing becomes the concluding step, ensuring the app is developed according to user expectations.

RESULTS AND DISCUSSION

Data Collection

The results of the Data Collection stage, Table 1, show systematic steps in detailing and obtaining relevant data for the stunting analysis. Identifying data sources thoroughly covered essential aspects such as anthropometric data, medical history, and environmental factors contributing to stunting. Next, the design of the questionnaire or data collection method is carefully constructed to ensure that the information generated matches the research needs. The data collection process includes two critical aspects: primary data collection through interviews or direct observation and secondary data collection from existing sources. To ensure the accuracy and credibility of the data, thorough verification and validation were conducted, including checking back in the field if necessary. Overall, this stage provides a solid foundation for accurate and reliable data in stunting analysis.

Table 1. Table 1. Data Collection

Data Type	Data Description
Anthropometry	Weight (kg): Child weight data to assess nutritional statusTinggi Body (cm): Child height data to assess child growth.
Health History	Immunisation History: Data on a child's immunisation status to assess immunity. Disease History: Information about any illnesses the child has had.
Environmental Factors	Air Pollution: Data on the level of air pollution around the child's neighbourhood.
Anthropometry	Nutrient Availability: Information on the availability of nutrients and nutrition that the child receives from the surrounding environment.

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Analyses of children's anthropometric data, medical history, and environmental factors indicate the potential for stunting. Substandard body weight and slow growth, especially if not age-appropriate, are of primary concern. A history of incomplete immunization may be an additional risk factor. Environmental factors, such as high levels of air pollution or low nutrient availability, can also play a role in stunting a child's growth. Through this analysis, appropriate interventions can be considered, including nutrition programs, improved access to immunization services, and measures to address environmental factors that contribute to stunting. Overall, intervention efforts should focus on improving child health and nutrition and environmental factors to prevent further potential stunting in the child population in question.

Application Development

The application development phase was executed successfully, incorporating an iterative approach and close team collaboration by the Extreme Programming (XP) method. Identifying critical features required in each iteration provided a clear direction for development. Continuous testing was the main focus to ensure ever-improving software quality throughout development. Implementing XP approaches, such as paired development, encourages intensive collaboration, improves the team's understanding of the code, and ensures that any changes are thoroughly tested. Regular code refactorings demonstrate a commitment to improving code cleanliness and structure, strengthening the foundation of reliable and maintainable software. Overall, the results of this stage reflect a systematic and adaptive approach to the development of stunting applications using Extreme Programming methods.

In the development phase of the stunting application, an iterative approach and close team collaboration using Extreme Programming (XP) methods were successfully implemented. Identifying key features in each iteration provided clear direction, while the focus on continuous testing improved software quality throughout the development process. Implementing XP approaches, such as paired development and exhaustive testing, strengthened team collaboration and deep understanding of the code. Regular code refactorings are committed to improving code cleanliness and structure, resulting in a reliable and maintainable software foundation. Overall, the results of this phase reflect a systematic, adaptive, and quality-focused approach, bringing positive benefits to the development of the stunting app.

Table 2. Application Features

Features	Description
Child Data Management	Child Registration and Profile: Allows users to register and create a child profile with personal and health information. Growth Monitoring: Tracking a child's anthropometric data, including weight, height, and other physical development.
Child Health Analysis	Health History: Store and manage a child's health history, including medical and immunizations. Health Evaluation: Provides an analysis of the child's health based on the data collected.

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Features	Description
Neighbourhood Data Integration	Environmental Monitoring: Integrate relevant environmental data, such as air quality and other environmental factors. Environmental Impact Analysis: Assess the impact of the environment on children's health and provide recommendations.
Reports and Visualisations	Report Generation: Produce regular reports on child health status and development. Data Visualisation: Present data in graphs and visualizations for easier understanding.

The stunting data integration application, Table 2, offers features detailing child data management, health analysis, environmental data integration, reports and visualization, paired development, continuous testing, and code refactoring. The strengths involve comprehensive monitoring of child growth, in-depth analysis of health, and integration of environmental data for risk factor identification. Reports and visualizations provide a clear understanding, while paired development and continuous testing improve team collaboration and software quality. Code refactorization confirms commitment to code cleanliness and readability. With attention to data validation and adaptation to modern development practices, the app aims to impact monitoring and address children's stunting positively.

User Acceptance Analysis

The User Requirements Analysis stage results include an in-depth understanding of user needs and expectations through stakeholder identification, interviews, and observations. The process of analyzing key features and prioritizing features based on user feedback forms the foundation for application development. Involving users in the early stages helps ensure that the app fulfills functional needs and accommodates users' preferences and desired layout. Testing prototypes at the end of the stage ensures that the development deliverables match user expectations and provide a satisfying experience. Thus, the user needs analysis results to provide a solid foundation for designing and developing responsive applications that meet user expectations.

Table 2. Application Feature Testing

Features	Scenario	Results
Child Data Management	Register new children by filling in profile information.	Child data is stored correctly and can be accessed and updated.
Child Health Analysis	Enter the child's health history and view health analyses.	Health analyses correspond to the data entered, and health history can be accessed and edited.
Neighbourhood Data	Add environmental data	Environmental data is

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Features	Scenario	Results
Integration	and see the impact on child health analyses.	properly integrated, and health analyses reflect its impact.
Reports and Visualisations	Generate child health reports and view growth data visualizations.	The report is well-crafted, and the visualizations provide a clear and informative picture.

By testing the features of the stunting data integration application, Table 3 successfully achieved the goals and user expectations. Child data management, health analysis, environmental data integration, reports, visualization, paired development, continuous testing, and code refactoring were analyzed and tested well. This success created a solid foundation for a reliable, responsive application that meets high-quality standards. Although some challenges, such as data validation and environment data maintenance, require extra attention, these tests provide confidence that the app is ready to be deployed and positively contribute to monitoring and addressing stunting in children.

User acceptance testing involved key stakeholders, and based on the results, the user satisfaction rate reached 87 percent. Stakeholders particularly appreciated the ease of use and clarity of information presented by the app. Features such as child data management, health analysis, and visualization reports helped support child health monitoring goals. Paired development and continuous testing were also positively assessed by stakeholders, enhancing team collaboration and app reliability. Although there were some suggestions for improvements to the visual design, the high level of satisfaction signaled that the app had successfully met the expectations and needs of the stakeholders. This evaluation will serve as a foundation to continuously improve the quality and functionality of the app to have a more positive impact on addressing stunting in children.

CONCLUSION

This research explores and develops a stunting data integration application with an Extreme Programming (XP) approach in software development that is responsive to changes and the needs of child health analysis. Titled "Agile Approach to Stunting Data Integration: An Extreme Programming Perspective," this research produced significant findings on applying XP principles in developing stunting applications. From application development involving data collection and user needs analysis to the user acceptance testing stage, this research demonstrates the effectiveness of the XP approach in improving team collaboration, software quality, and responsiveness to changing needs. Testing of the application's features and user acceptance evaluation indicated that the application successfully met user expectations and satisfaction, with a satisfaction rate of 87 percent, according to stakeholder testing results. This conclusion confirms that agile approaches, notably XP, have great potential in the development of health applications such as stunting

data integration, and the contribution of this research is expected to provide direction and inspiration for future research and development in similar domains.

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