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Development of a Smart Village Application to Support Local Administration and Public Service Delivery in Vaviquinea Village, Maubara Municipality

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KEYWORDS
Smart Village; Digital Governance; Local Administration; Public Services; Web-Based Application

ABSTRACT
Digital transformation in rural governance is crucial for improving administrative efficiency and the quality of public services, particularly in areas with limited infrastructure. Currently, most administrative processes at the Desa level are still conducted manually, resulting in data fragmentation, prolonged service times, and limited access to information. This study aims to design, develop, and implement a web-based Smart Village application in Desa Vaviquinea, Maubara Administrative Post, Timor-Leste. A Research and Development (R&D) approach was employed using the System Development Life Cycle (SDLC) framework, which includes requirements analysis, system design, implementation, functional testing, and user evaluation. Data were collected through field observations, semi-structured interviews, document analysis, and user questionnaires (N = 50; 10 Desa staff and 40 community members). The application integrates population data management, administrative letter services, dissemination of public information, as well as online application submissions and complaint handling. Evaluation results indicate a 60% reduction in processing time, a 2% error rate, and a user satisfaction score of 4.2 out of 5, demonstrating improvements in administrative efficiency, transparency, and responsiveness. This study presents a contextual Smart Village model for rural areas in Timor-Leste and can be replicated in other Desas with similar characteristics.

INTRODUCTION

Digital transformation has become an important factor in improving administrative efficiency, quality of public services, and community participation at the local level. In Timor-Leste, most village administrations still rely on traditional manual processes, leading to data fragmentation, delays in service completion, and low citizen engagement (Government of Timor-Leste, 2020; Ministry of Home Affairs, 2021). Population data is often stored in separate physical documents, making it difficult to access, update, and manage effectively (Prasetyo, 2018). As a result, administrative processes such as managing correspondence, recording service requests, and managing citizen data take days to weeks, reducing the responsiveness of

the village government (Indonesian Central Statistics Agency, 2021; Ximenes & da Silva, 2023).

In addition to efficiency issues, limited access to official information and grievance channels makes it difficult for residents to participate in local decision-making processes, resulting in low public participation in village administration (Hermawan, 2020; (Kurniawan, 2021; Smith & Anand, 2021). This condition emphasizes the need for the implementation of a digital system that can integrate all administrative and communication services with the community, while increasing transparency and accountability (Lindquist & Huse, 2017; Saldanha et al., 2022; Sarifudin & Damanik, 2024; Setyarto et al., 2025).

The Smart Village concept emerged as an adaptive solution that adapts the principles of Smart City to rural conditions. Smart Villages enable the integration of administrative services, dissemination of public information, and citizen participation through web-based platforms, while taking into account the limitations of infrastructure and local digital literacy levels (Kumar & Gupta, 2022; Ministry of Villages, Development of Disadvantaged Regions, and Transmigration, 2022). The initial implementation of Smart Villages in several villages in Timor-Leste has shown positive results, including increased administrative transparency by up to 40%, acceleration of services, and increased community satisfaction (Santoso, 2019).

Vaviquinea Village is a study location that represents villages with manual administrative challenges, limited resources, and simple infrastructure. The village needs centralized data management, digital correspondence services, and online complaint and request channels to increase citizen engagement. This research aims to develop a web-based Smart Village application that can improve operational efficiency, transparency, responsiveness of public services, and provide a model that can be replicated in other villages with similar characteristics. With this system, it is hoped that the administrative process will be faster, more accurate, participatory, and able to increase public trust in local government.

METHOD

This study employed a Research and Development (R&D) approach using the SDLC framework to design, develop, test, and implement the Smart Village application iteratively. The research was conducted in Vaviquinea Village, Maubara Regency, involving 50 participants, consisting of 10 village staff and 40 community members. Purposive sampling was applied to select participants who are directly involved in or interact with village administrative processes.

Data Collection Methods

In this study, data collection was carried out comprehensively using the triangulation method to obtain valid and accurate results. Here is a breakdown of the methods used:

Table 1. Data Collection Methods

Method	Purpose	Participants / Sources
Field Observation	Understand workflows and constraints	Village Staff & Community
Semi-Structured Interviews	Identify system requirements	Village Staff & Community Representatives
Document Analysis	Review administrative and policy archives	Physical & digital documents
Questionnaire / Survey	Assess satisfaction and service priorities	40 community & 10 Village staff

RESULTS AND DISCUSSION

Description of Research Results

The system development for the Smart Village application follows a structured and systematic framework using the SDLC (System Development Life Cycle) model. The development process includes several stages: first, a needs analysis covering functional requirements such as population management, applications, and complaints, as well as non-functional requirements like usability, security, and accessibility (Raharjo, 2017; Setyawan, 2020). Second, system design involves creating the database schema, role-based access, UI mockups, and workflow diagrams. Third, implementation is carried out through web-based development using PHP, JavaScript, and MySQL, with modules including population management, correspondence, public information, and online applications/complaints. Fourth, testing and evaluation are conducted to assess system functionality, usability, and performance. Finally, the system is implemented live and maintained with iterative improvements based on user feedback.

System analysis is a fundamental stage used by the researcher to identify system requirements based on entities, workflows, and ongoing processes within the system. This analysis helps in designing a system that aligns with the needs of both users and the organization. One of the tools employed in this stage is the use case diagram, which models the interactions between users (actors) and the system. The diagram illustrates the main

functionalities that each actor can perform within the system, providing a clear overview of user-system interactions and guiding subsequent system design and development.

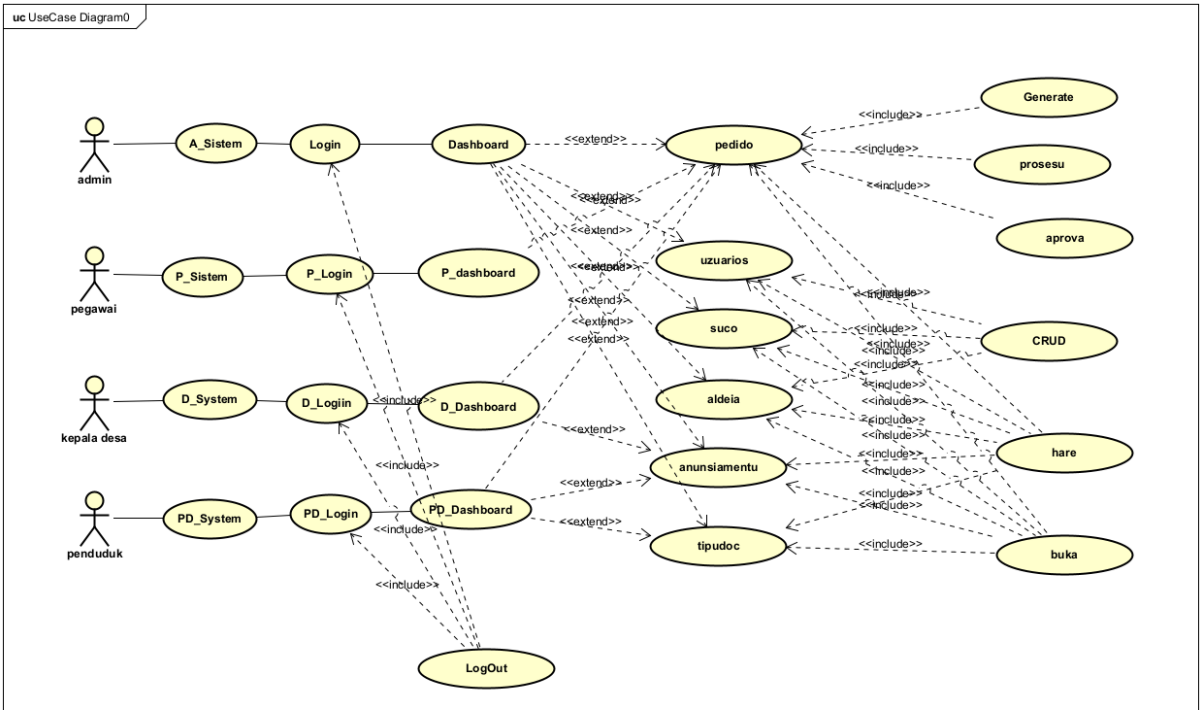


Figure 2. Use Case Diagram

Activity Diagram

Activity diagrams describe the flow of processes or activities in the system in detail. This diagram shows the sequence of steps taken by the user and the system in completing a process.

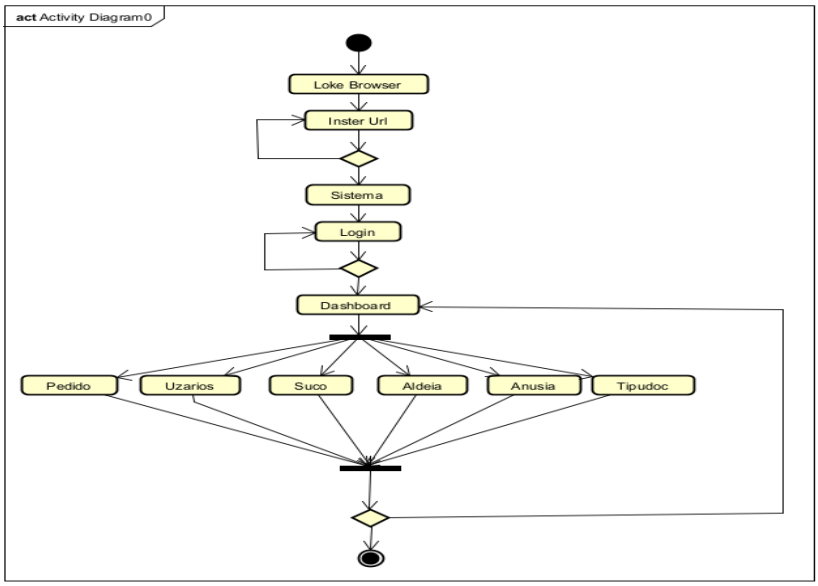


Figure 3. Activity Diagram

Class Diagram

Diagram classes are used to model the structure of a system staticly. This diagram shows the classes, attributes, methods, and relationships between classes that make up the system.

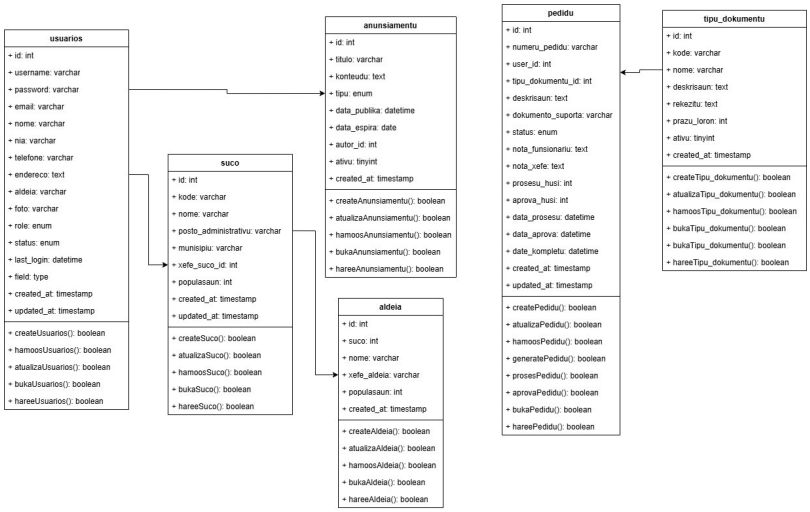


Figure 4. Class Diagram

System Implementation

System implementation describes the interface and functionality available to each user within the Smart Village system in Desa Vaviquinea. The admin page is designed to control all data within the system, including village information, community data, and related documents. Administrators have full access to manage and maintain the system's data, ensuring that all operations run smoothly and that information remains accurate and up to date.

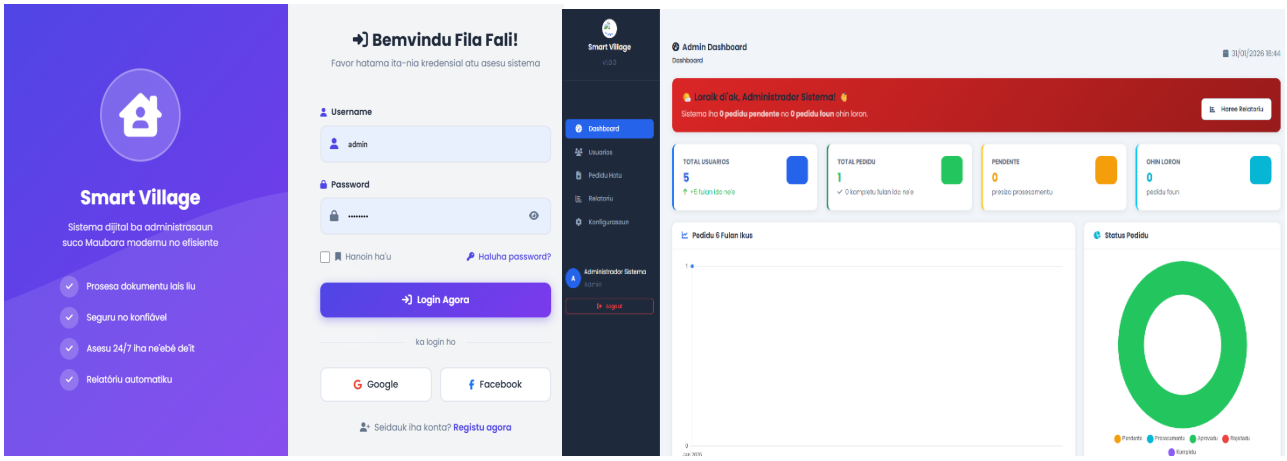
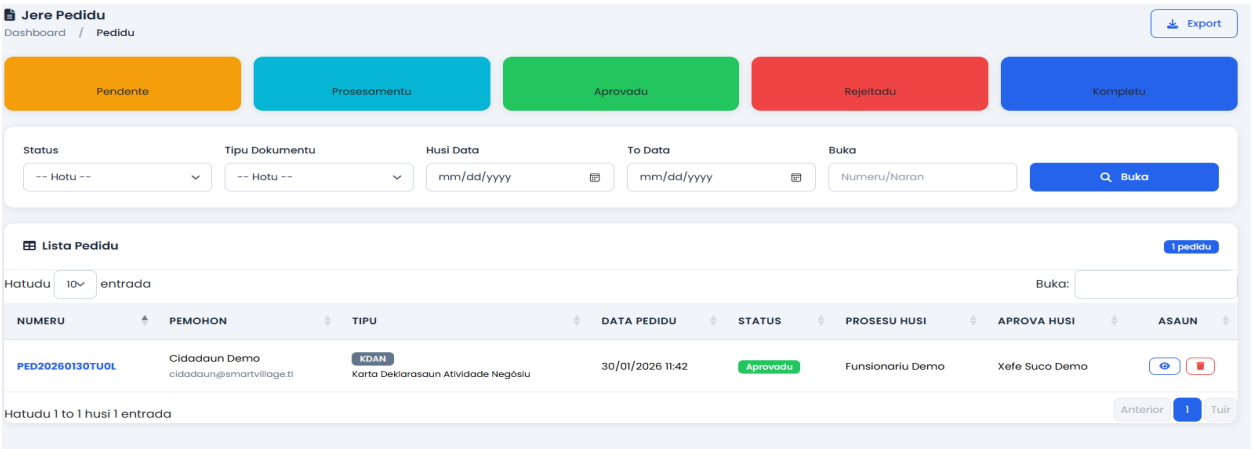


Figure 5. Admin Page



Village Head / Village Head Page

The Village Head page or (Xefe Desa) is used to manage requests from employees related to the management of letters and other data that require approval or action from the village head.

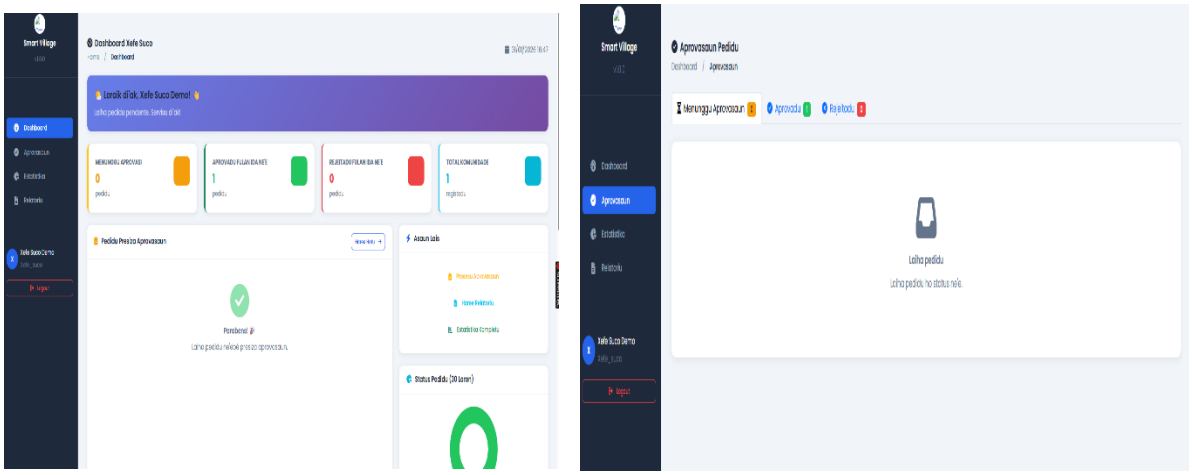


Figure 6. Village Head / Village Head Page

Officer/Employee Page

The Employee or Employee page is used to process and receive requests from the community. Employees are responsible for ensuring that the management of the letter can be forwarded to the Village Head for further action.

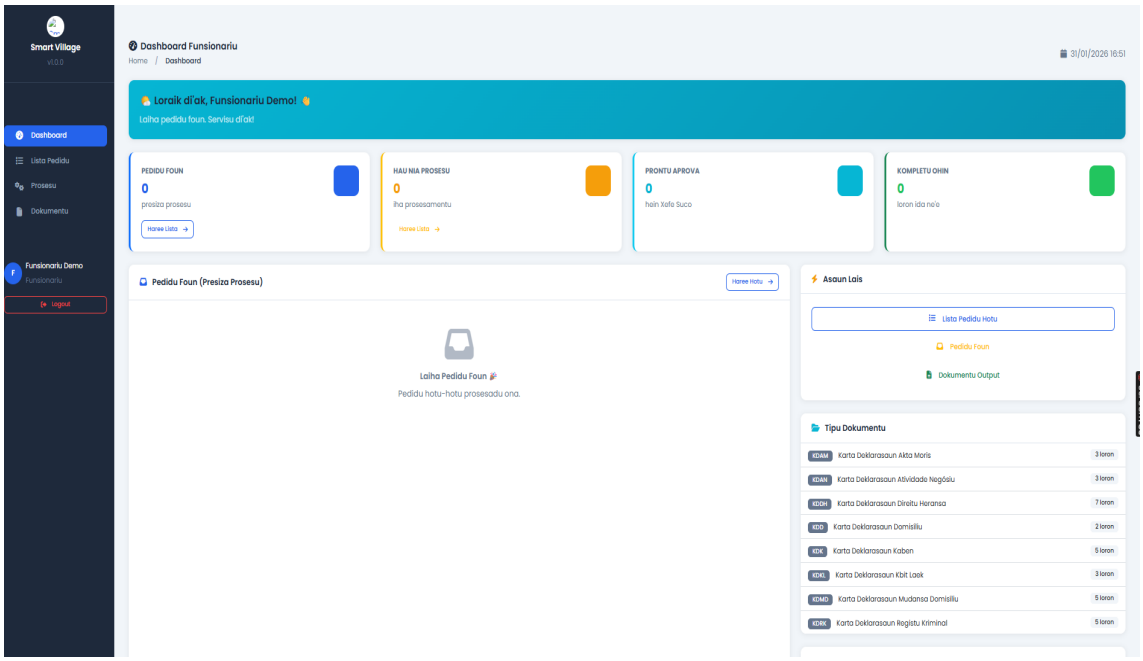


Figure 7. Officer/Employee Page

Community Page / Komuniti

The Community page is used by residents to apply for various types of mail management. This page allows the public to do the application process directly which will then be forwarded to the employee level.

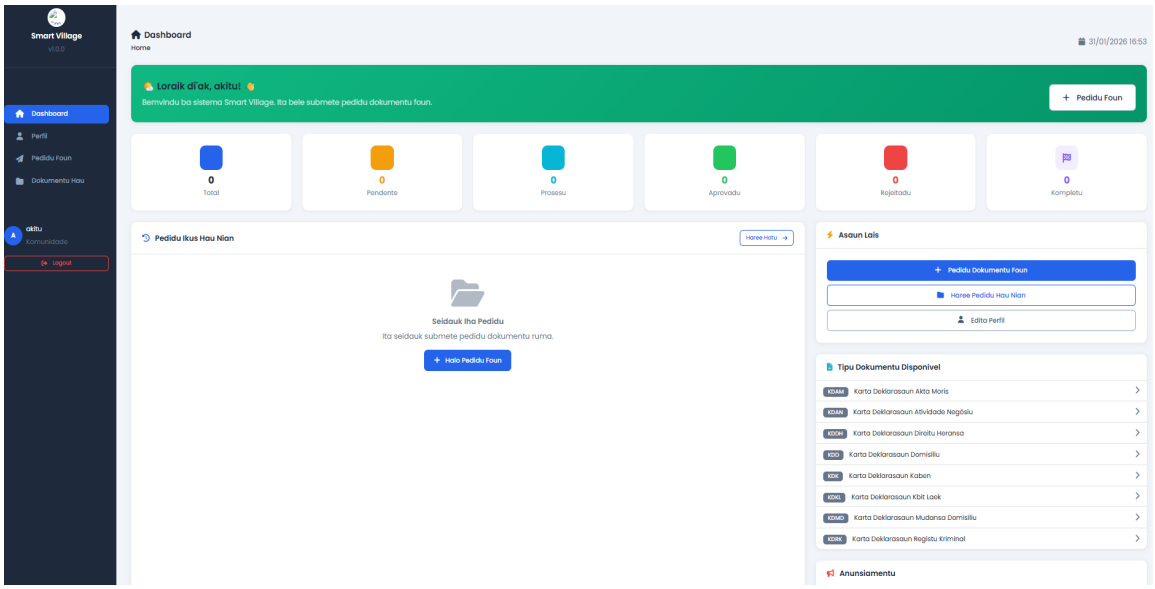


Figure 8. Community Page / Komuniti

Test Results

From the results of the test with feadback from the system user based on rool with user P=50; 10 Village staff and 40 communities), the following is a summary of the system testing using the blcak box method and using items.

Table 2. System Teste Summary

Role/Module	Total Test Case	Pass	Files	Pass Rate
Admin	10	10	0	100%
Village Head	8	8	0	100%
Employees	8	8	0	100%
Society	10	10	0	100%
System	8	8	0	100%
TOTAL	**44**	**44**	**0**	**100%**

System Functionality

Table 3. System Functional Testing

Yes	Modules/Features	Testing Scenarios	Test Case	Expected Results	Test Results	Status
1	Security	SQL Injection	Input: ' OR '1'='1	System rejects input	As expected	✓ Pass
2	Session	Timeout session	Idle 30 minutes	Car logout	As expected	✓ Pass
3	Responsive	Mobile access	Open on your smartphone	Layout customize	As expected	✓ Pass
4	Multi Browser	Test on various browsers	Chrome, Firefox, Edge	Normal functioning	As expected	✓ Pass

5	Performance	Load data 1000 records	Population data query	Load < 3 seconds	As expected	✓ Pass
6	Competitor User	50 concurrent users	Simulation 50 logins	The system remains stable	As expected	✓ Pass
7	Error Handling	Server down	Turn off the database	An informative error message appears	As expected	✓ Pass
8	Data Validation	Custom character input	Input @#$% in the name	Character filter system	As expected	✓ Pass

CONCLUSION

This research successfully designed, developed, and implemented a web-based Smart Village application to support local administration and public services in Vaviquinea Village, Maubara Administrative Post, Timor-Leste. With the Research and Development (R&D) approach and the System Development Life Cycle (SDLC) framework, the system is developed systematically from the needs analysis to the implementation stage and user evaluation. The results of the implementation show that the Smart Village application is able to integrate population data management, correspondence services, public information dissemination, and online application and complaint submission services. The system evaluation showed a decrease in service processing time of up to 60%, a system error rate of 2%, and a user satisfaction rate of 4.2 out of 5, which indicates an increase in efficiency, transparency, and responsiveness of village administration. Thus, the Smart Village application developed has proven to be effective as a digital solution to overcome manual administration problems at the village level. This system model is contextual and flexible so it has the potential to be replicated and adapted to other villages in Timor-Leste that have similar characteristics and challenges.

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