

An AI-Integrated Moodle-Based E-Learning Platform for Youth Leadership Development in Rural Communities

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ABSTRACT

Leadership learning for youth communities currently faces limitations, particularly the lack of a structured, flexible, and easily accessible learning platform. The learning process at Local Heroes Schools still relies on face-to-face meetings and the Zoom platform, thus suboptimally supporting learning effectiveness. This study aims to develop and analyze the feasibility of a Moodle-based Local Heroes School E-Learning platform equipped with an interactive chatbot built on the FastBots.ai platform, developed as a leadership learning medium for Desamind Chapter Devices in various districts in Indonesia. The research method used is Research and Development (R&D) with a 4D development model, which includes the Define, Design, Develop, and Disseminate stages; in this study the Disseminate stage was limited in scope to a pilot trial among Desamind Chapter Device users. System testing was conducted through black-box testing by a software engineering expert, validation by media experts and material experts, and user trials using the System Usability Scale (SUS). The results showed that black-box testing on the evaluated scenario achieved a 100% success rate. Media expert validation obtained a score of 93.75%, categorized as Very Feasible, while material expert validation obtained a score of 100%, categorized as Valid. User trials involving 30 respondents produced a mean SUS score of 75.75 (SD = 11.14), categorized as Acceptable, although 40% of respondents rated the platform in the Marginal range. Based on these results, the Moodle-based Local Heroes School E-Learning platform integrated with a FastBots.ai chatbot is feasible for use as a leadership learning medium; however, the incremental contribution of the chatbot specifically, and dissemination beyond this pilot, warrant further study.

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1. INTRODUCTION

The development of Information and Communication Technology (ICT) in the digital era has brought significant changes to the world of education. Technological advances enable more flexible learning processes, without the constraints of space and time, and support faster and broader access to information (Dhawan, 2020). ICT plays a crucial role in improving the quality of education by providing various platforms and media that support independent learning and student skill development (Syamsuar & Reflianto, 2019), many learning systems still rely on conventional, less interactive methods and have not fully utilized the potential of digital technology (Anggara, 2017).

The use of e-learning is one solution to address these challenges. E-learning enables distance learning with the support of various features such as digital materials, discussion forums, learning videos, and online evaluations (Hakim, 2016; Magdalena et al., 2020). Various informal learning platforms in Indonesia have developed rapidly and demonstrated their effectiveness in supporting technology-based learning (Fantini & Tamba, 2020). However, there are still limited platforms that specifically focus on developing the capacity of village youth as agents of change (local heroes) in village development.

Data shows that the proportion of youth in rural Indonesia is quite large. However, their contribution to social projects and village development remains suboptimal (Pratama & Rahmat, 2018). This situation is influenced by limited access to structured education, information disparities between rural and urban areas (Hadi, 2018; Nasution, 2016; Rahma et al., 2023), and the lack of integrated and easily accessible learning platforms (Seretse et al., 2018). Therefore, innovative learning media are needed that can reach rural youth in a more systematic and sustainable manner.

Desamind Indonesia, an organization focused on youth capacity development, has a Local Heroes School program aimed at developing rural youth into agents of change in their respective regions. However, to date, the learning process in this program is still conducted through online meetings using Zoom and offline activities, with materials distributed through various platforms such as WhatsApp and Google Drive. This situation results in learning that is not centralized, lacks structure, and makes it difficult for participants to access materials consistently. Moodle is an open-source e-learning platform with comprehensive features and comprehensive support for online learning (Dhika et al., 2020). According to Darmawan (2014), Moodle's strength lies in its flexibility in managing materials, discussion forums, quizzes, and tracking participant learning activities. Furthermore, chatbot integration into e-learning systems can improve the effectiveness of learning services by providing automated responses to participant questions quickly and accurately (Harahap & Liza, 2020). Chatbots function as conversational agents capable of simulating communication interactions, helping users obtain information without having to wait for responses from administrators or facilitators (Hormansyah & Utama, 2018).

In recent years, the integration of chatbots into Learning Management Systems has attracted growing scholarly attention. Systematic reviews report that AI-based chatbots can support personalized learning, provide round-the-clock assistance, and improve learning achievement across a range of educational settings (Hwang & Chang, 2023; Labadze et al., 2023), while evidence focusing specifically on generative AI-based chatbots shows similarly positive, though still emerging, effects on learning engagement and outcomes (Weng et al., 2024). Within the Moodle ecosystem specifically, prior work has typically implemented chatbots as purpose-built plugins or custom natural-language-processing pipelines connected to Moodle, such as Dialogflow-based assistants (Shilowaras & Jusoh, 2022) or bespoke chatbot services built directly on top of an LMS (Chaskopoulos et al., 2022). These approaches generally require in-house software development capacity and target formal higher-education users. The present study differs from this body of work in two respects. First, rather than building a bespoke chatbot pipeline, it integrates a no-code, third-party generative AI chatbot platform (FastBots.ai) into Moodle, a deployment model that is more feasible for a community organization such as Desamind Indonesia, which does not have a dedicated software development team. Second, whereas most existing Moodle-chatbot studies target formal higher-education students, this study targets an underserved, non-formal audience, namely rural youth leadership cadres (Desamind Chapter Devices), for whom structured, low-maintenance digital learning infrastructure has not previously been documented in the literature. This combination of deployment model and target population constitutes the scientific gap that this study addresses.

Based on these issues, this research aims to develop and evaluate the feasibility of a Moodle-based Local Heroes School e-learning platform equipped with an interactive, FastBots.ai-based chatbot, designed as a leadership learning tool for Desamind Chapters in various regencies across Indonesia. Specifically, this study addresses three research questions: (1) how is the platform designed and developed through the Define, Design, Develop, and Disseminate stages; (2) how feasible is the platform in terms of functionality, as well as media and material validity; and (3) how usable is the platform, as perceived by a pilot group of Desamind Chapter Device users, based on the System Usability Scale. The platform is intended to provide a structured, flexible, and integrated learning system that supports the capacity building of village youth more effectively and efficiently; the empirical evaluation reported in this study, however, is limited to a single Desamind location and a 30-respondent pilot trial, with wider dissemination across regencies identified as a direction for future work.

2. METHOD

This research uses the 4D development model (Four-D Model) proposed by Thiagarajan. This model consists of four main stages: Define, Design, Develop, and Disseminate. The 4D model was chosen because it provides systematic and structured steps in the learning media development process,

starting from the needs analysis stage to the product implementation stage. An illustration of the 4D development model is shown in Figure 1 (Yetti & Ahyanuardi, 2020)

This research was conducted in 2025 at the Desamind Indonesia Foundation. Geographically, the research location is Samporan, Girioto Village, Ngemplak District, Boyolali Regency, Central Java.

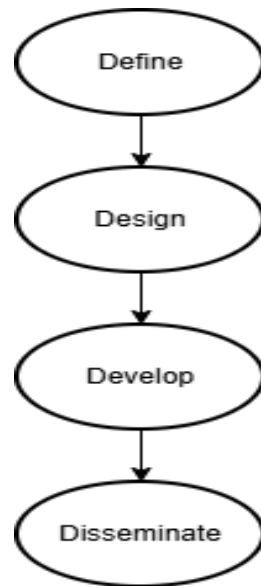


Figure 1. 4D model (Yetti & Ahyanuardi, 2020)

The research subject for the functionality testing was the Moodle-based Local Heroes School e-Learning platform, which was tested by one software engineering expert. The media and material feasibility test involved two media experts and two material experts. Meanwhile, the usability test was conducted on 30 Desamind Chapter devices as system users using the System Usability Scale (SUS). The researchers used validated observations, questionnaires, and research instruments as data collection techniques.

The data analysis technique in this study employed quantitative descriptive analysis. Media feasibility data were obtained from validation results by media experts, software engineering experts, and users, which were then converted into scores based on a Likert scale. The data were analyzed by calculating the average answer based on the scores of each item and respondent. According to Arikunto (1993), the feasibility percentage was calculated using the following formula (1):

$$\% \text{ Eligibility} = \frac{\sum \text{Score}}{\sum \text{Max Score}} \times 100\% \quad (1)$$

The results of the calculations are then converted into a table of media suitability criteria as shown in Table 1.

Table 1. Classification of feasibility test assessment (Arikunto, 2013)

Percentage of Interpretation	Interpretation
81% - 100%	Excellent
61% - 80%	Very Good
41% - 60%	Good
21% - 40%	Fair
0% - 20%	Not Worthy

The data analysis technique for material feasibility was obtained from the results of validation by material experts using the Guttman scale instrument. Respondents' answers were converted into a score of 1 for "Yes" and 0 for "No". According to Riduwan (2009), the assessment interval to determine validity was calculated using the formula (2):

$$V = \frac{f}{n} \times 100\% \quad (2)$$

where:

V : Validity value

f : Score obtained

n : Maximum score

Based on the interval calculation, the assessment classification by material experts can be seen in Table 2.

Table 2. Classification of assessment by subject experts

Percentage	Clarification
Interval > 50%	Valid
Interval < 50%	Invalid

Functionality testing was conducted using the black-box testing method, with test cases presented to software engineers. The testing instrument used the Guttman scale, with two answer options: success or failure. The system was deemed to have met the functionality criteria if all features performed according to the designed specifications.

Usability analysis was conducted using the System Usability Scale (SUS). Data was obtained from 30 user respondents who had tested the system and calculated using standard SUS procedures. Each respondent's score was converted to a range of 0–100. According to Kurniawan et al. (2022), the final SUS score was calculated using formula (3):

$$\bar{x} = \frac{\sum x}{n} \quad (3)$$

where:

$\bar{x}$ = average SUS score

$\sum x$ = total System Usability Scale (SUS) score

n = number of respondents

The scores are then interpreted based on ranking and acceptability categories to determine the system's user acceptance. As shown in Table 3, the SUS score is first converted into a letter grade ranging from A to E, while Table 4 further classifies the same score into one of three acceptability categories, namely Not Acceptable, Marginal, or Acceptable. In addition to functionality and usability testing, compatibility testing was conducted to verify that the platform rendered and functioned consistently across three commonly used web browsers, namely Google Chrome, Microsoft Edge, and Mozilla Firefox, examining page layout, responsiveness, and the functioning of interactive features, including the chatbot, in each browser. It should also be noted that the SUS instrument used in the user trial evaluated the Local Heroes School platform as a whole, encompassing the Moodle interface together with the entry point to the chatbot feature embedded within it, rather than the conversational quality of the chatbot specifically; this distinction, and its implications for interpreting the chatbot's contribution, are addressed further in the Discussion.

Table 3. Interpretation of SUS scores based on ranking (Ardhana, 2022).

Grade	Score Range
A	Score $\geq 80,3$
B	Score ≥ 74 and $< 80,3$
C	Score ≥ 68 and < 74
D	Score ≥ 51 and < 68
E	Score < 51

Table 4. Range of SUS assessment acceptance (Ardhana, 2022).

Score	Meaning
0 – 50,9	Not Acceptable
51 - 70,9	Marginal
71 - 100	Acceptable

3. RESULT AND DISCUSSION

The development of Local Heroes School E-Learning as a leadership learning medium is carried out through a 4D development model which includes four stages, namely definition, design, development, and dissemination.

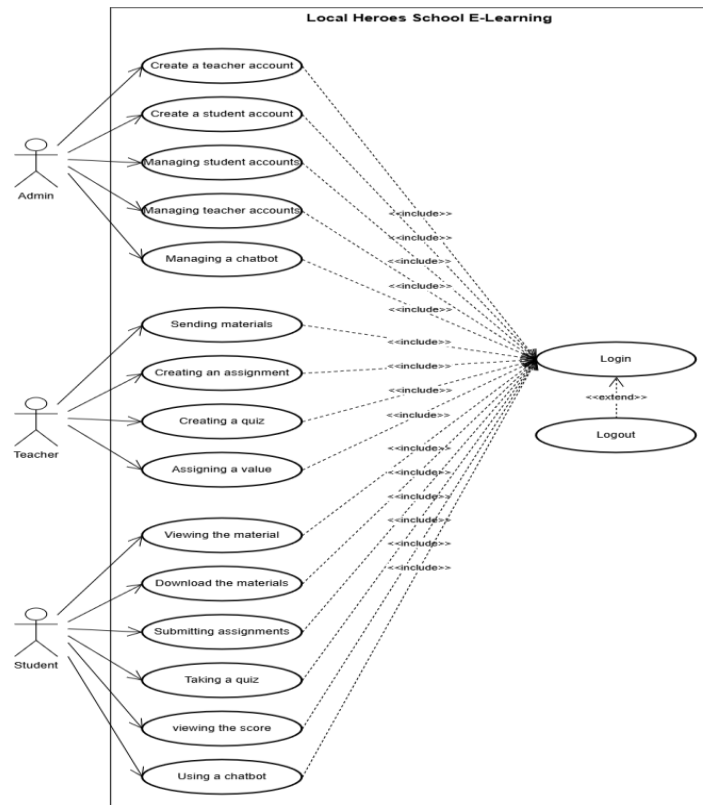


Figure 2. Use case diagram of the sekolah local heroes e-learning platform

The analysis in the definition stage aims to identify needs for developing learning media. The content developed for the Local Heroes School E-Learning program includes leadership materials and learning modules designed to support the capacity development of the Desamind Chapter device. This stage also analyzes user characteristics and system requirements to ensure optimal platform accessibility via computers and smartphones connected to the internet.

The design stage involves developing the system design and media interface for the developed media. System design includes the creation of UML diagrams, specifically use case diagrams, to illustrate the interaction flow between users and the system, as shown in Figure 2.

The next stage is media implementation based on the established design. Implementation is carried out using the Moodle platform, with the appearance and features adjusted to meet the leadership learning needs. Implemented features include the main page, user management (admin, teacher, and participant), material modules, discussion forums, quizzes, and an interactive chatbot. Details of the system interface implementation results are presented below.



Figure 3. Homepage

As shown in Figure 3, the homepage is the primary learning platform for the Local Heroes School, displaying information related to learning media titles. It also provides the main menu, including login options and language settings to suit user needs.

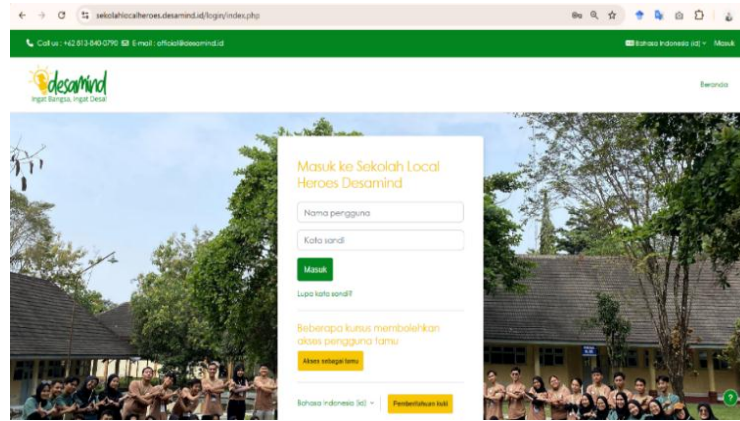


Figure 4. Login page

As illustrated in Figure 4, through this page, users can access various available content and courses by logging in using their registered username and password.

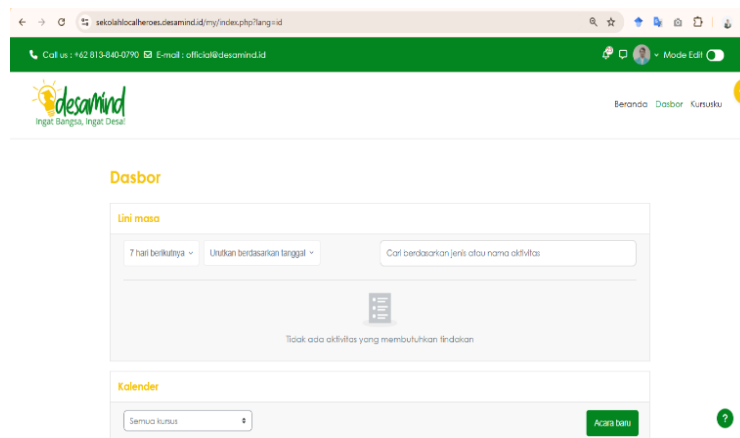


Figure 5. Dashboard page

As shown in Figure 5, the dashboard page displays a course timeline and calendar that functions to monitor the user's progress and learning activities.

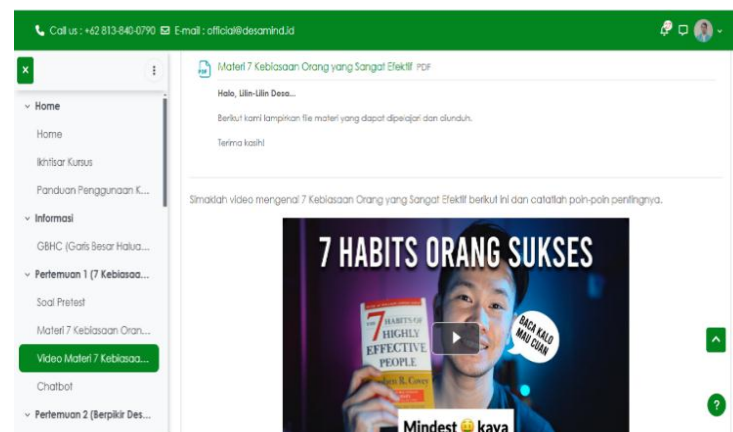


Figure 6. Courses pages

As shown in Figure 6, the course page menu displays various learning materials for the Desamind Chapter Toolkit. In this menu, users can access relevant content and utilize chatbot features to support interaction and obtain additional assistance.

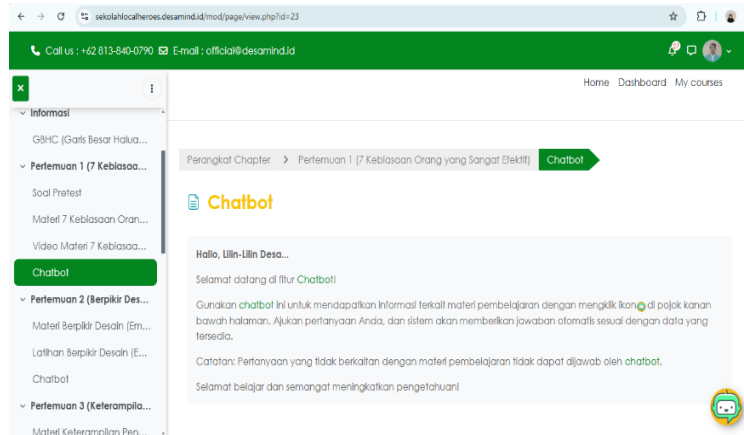


Figure 7. Material page

As shown in Figure 7, the content page menu presents learning materials in the form of videos and document modules that users can access and review. The materials are prepared by Desamind leadership training facilitators as the primary teaching materials. Additionally, assignments and quizzes are available to assess participant understanding.

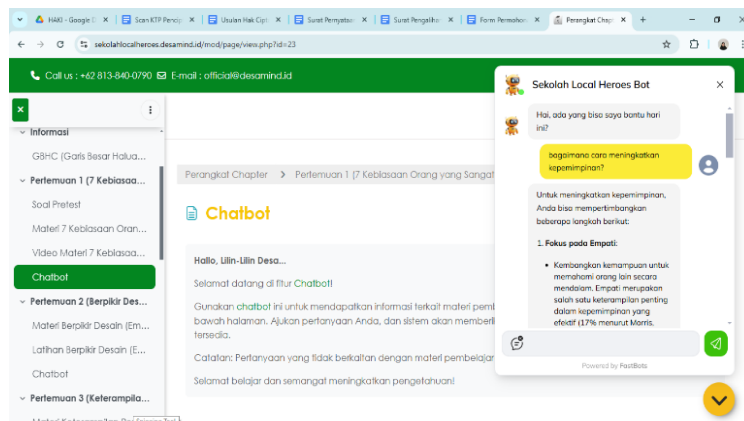


Figure 8. Chatbot page

As shown in Figure 8, the Local Heroes School page displays a chatbot icon on the screen that allows users to access the chatbot feature. Users can click the chatbot icon to open the chatbot and start interacting with it to obtain information related to the learning materials.

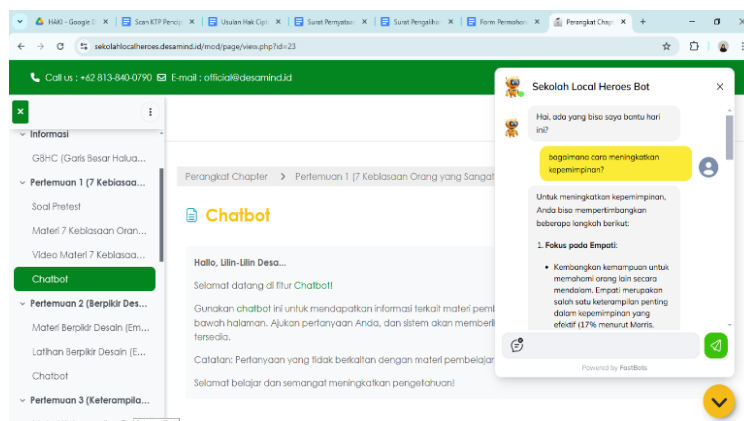


Figure 9. Asking the chatbot about leadership learning materials

As shown in Figure 9, the Local Heroes School chatbot page provides an interaction area between users and the chatbot. Users can submit questions related to the leadership learning materials through the provided question field.

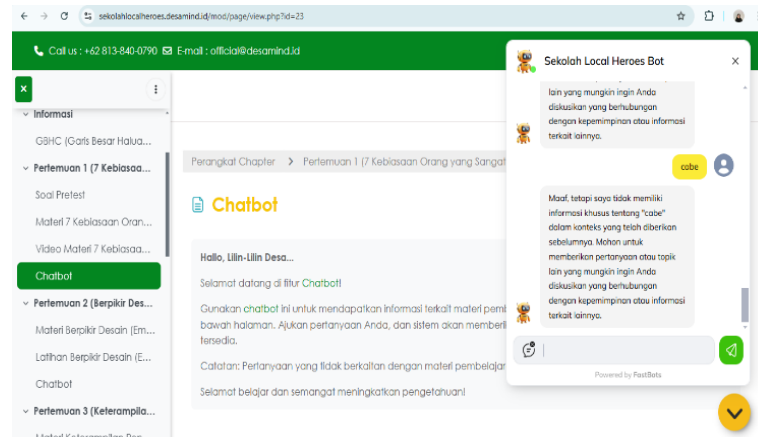


Figure 10. Asking the chatbot about topics unrelated to learning

As shown in Figure 10, the Local Heroes School chatbot page displays a response when users ask questions unrelated to the leadership learning materials. The chatbot provides a response indicating that the requested information is not available and directs users to ask questions related to leadership or other relevant topics.

Functionality testing of the platform was carried out using the black-box testing method by one software engineering expert, covering 37 test scenarios across the Admin, Teacher, and Student interfaces, including login behavior, course and user management, material upload and download, quiz handling, profile management, logout, and chatbot display and response behavior for both leadership-related and out-of-scope queries. As shown in Table 5, all 37 scenarios performed according to the designed specifications, yielding a 100% success rate; the full scenario-by-scenario checklist is available from the corresponding author upon request.

Table 5. Functional suitability test results

Tested Function Group	Succeeded	Failed
Admin interface (10 scenarios)	10	0
Teacher interface (15 scenarios)	15	0
Student interface (12 scenarios)	12	0
Total	37	0
Percentage	100%	0%

Following functionality testing, the platform's media quality was validated by two media experts using a Likert-scale instrument. As shown in Table 6, this validation yielded an overall score of 93.75%, categorized as Very Feasible.

Table 6. Media expert validity assessment results

No	Indicator	Total Score	Score Max	Percentage	Classification
A. Interface Design Aspects					
1.	Page layout consistency	9	10	90%	Very Feasible
2.	Theme selection appeal	8	10	80%	Feasible
3.	Background color selection accuracy	10	10	100%	Very Feasible
4.	Text color selection accuracy	10	10	100%	Very Feasible
5.	Button color selection accuracy	10	10	100%	Very Feasible
6.	Button symbol selection consistency	9	10	90%	Very Feasible
7.	Navigation functionality accuracy	9	10	90%	Very Feasible
8.	Ease of navigation	8	8	100%	Very Feasible
B. Media Presentation Quality Aspects					
9.	Relevance of images to the material	9	10	90%	Very Feasible
10.	Clarity of images to clarify information	9	10	90%	Very Feasible
11.	Accuracy in selecting image color combinations	9	10	90%	Very Feasible
12.	Suitability of font selection and clarity of font size	9	10	90%	Very Feasible
13.	Suitability of capitalization	10	10	100%	Very Feasible

14.	Ease of understanding of sentences	10	10	100%	Very Feasible
C. Feature Aspects In E-Learning					
15.	Ease of access	10	10	100%	Very Feasible
16.	Access speed	7	8	87.50%	Very Feasible
17.	Network stability	9	10	90%	Very Feasible
18.	Reliability	9	10	90%	Very Feasible
19.	Rich learning media resources	8	8	100%	Very Feasible
20.	Ability to bridge learning	8	8	100%	Very Feasible
Total Score		180	192	93.75%	Very Feasible

The leadership content itself was separately validated by two material experts. As shown in Table 7, this validation yielded a score of 100%, categorized as Valid.

Table 7. Results of the validity assessment by subject experts

No.	Aspect	Score		Total
		Exp 1	Exp 2	
1.	7 Habits of Highly Effective People	1	1	2
2.	Self-Management Skills	1	1	2
3.	Design Thinking (Empathy, Integrity, Communication Skills)	1	1	2
4.	Teamwork (Collaboration, Team Management, Team Leadership)	1	1	2
5.	Future Skills	1	1	2
Total		5	5	10
Category/Percentage		Valid	Valid	100%

Compatibility testing was carried out to confirm that the platform rendered and functioned consistently across commonly used web browsers, namely Google Chrome, Microsoft Edge, and Mozilla Firefox. The platform's page layout, navigation, and interactive elements, including the chatbot, were checked in each browser. All three browsers displayed the platform correctly and supported its interactive features without notable problems, indicating that the E-Learning Local Heroes School platform is not tied to a single browser and can be accessed according to users' preferences. User trial results, obtained from 30 Desamind Chapter Device respondents using the System Usability Scale, are presented in Table 8.

Table 8. SUS assessment results by user experts

No	Total Raw Score (10 Items)	Final Score ($\times 2,5$)	Assessment Classification
1	30	75	Acceptable
2	26	65	Marginal
3	31	77,5	Acceptable
4	33	82,5	Acceptable
5	27	67,5	Marginal
6	21	52,5	Marginal
7	28	70	Marginal
8	31	77,5	Acceptable
9	28	70	Marginal
10	30	75	Acceptable
11	36	90	Acceptable
12	25	62,5	Marginal
13	34	85	Acceptable
14	32	80	Acceptable
15	37	92,5	Acceptable
16	32	80	Acceptable
17	33	82,5	Acceptable
18	37	92,5	Acceptable
19	23	57,5	Marginal
20	31	77,5	Acceptable
21	26	65	Marginal
22	31	77,5	Acceptable
23	28	70	Marginal

24	39	97,5	Acceptable
25	36	90	Acceptable
26	25	62,5	Marginal
27	28	70	Marginal
28	25	62,5	Marginal
29	34	85	Acceptable
30	32	80	Acceptable
Total	909	2272,5	
Average	30,3	75,75	Acceptable

To further characterize these results, the mean SUS score of 75.75 was accompanied by a standard deviation of 11.14 (range 52.5-97.5). Of the 30 respondents, 18 (60%) fell in the Acceptable range and 12 (40%) fell in the Marginal range, with none rated Not Acceptable, indicating that a substantial minority of users experienced the platform as only marginally usable. An item-level analysis of the ten SUS statements showed that respondents rated item 1 ("I would be happy to use this platform frequently") most favorably, while item 10 ("I needed to get used to the system before I could use it well") and item 4 ("I needed help from someone else to use this platform") received the least favorable ratings. This pattern suggests that the Marginal-range scores were driven primarily by first-use learnability and onboarding friction rather than by dissatisfaction with the platform's features or content, which is plausible for a rural, non-formal user population for whom a structured LMS interface may be less familiar than everyday consumer applications such as WhatsApp. This finding points to a concrete, low-cost improvement, namely a brief guided onboarding tutorial or an in-platform help panel, rather than a redesign of core functionality.

Beyond the validation and usability results reported above, the Disseminate stage of the 4D model was carried out by hosting the completed platform on a live server (<https://sekolahlocalheroes.desamind.id>) during the 2025 data-collection period, and implementing it for trial use by the 30 Desamind Chapter Device respondents whose System Usability Scale results are reported in Table 8. This hosting and pilot implementation constitute the empirical evidence for the Disseminate stage in this study; the deployment was subsequently discontinued and is no longer active. Wider diffusion of the platform to Desamind Chapters across additional regencies had not yet taken place at the time of writing and is identified as a direction for future dissemination and evaluation.

In this research, the Local Heroes School e-Learning platform was developed as a Moodle-based leadership learning platform for young people in villages, equipped with a chatbot feature. This platform is designed to provide flexible and efficient leadership training, allowing participants to access learning anytime and anywhere. One of the platform's advantages is its FastBots.ai-based chatbot feature, which makes it easy for users to ask questions related to leadership material directly without having to wait for a response from the administrator. This chatbot is designed to provide valid answers and align with the material references specified by the training facilitator. This platform has 7 main menus that can be used by users, including: (1) home: this home menu contains information about the Local Heroes School learning media, (2) login: this login menu provides access for users to enter the learning system according to their respective accounts, (3) dashboard: this dashboard menu displays the course timeline and calendar to track user progress at the Local Heroes School, (4) my course: this my course menu displays a display of courses available at the Local Heroes School, (5) course: this course menu contains a display of courses from the Desamind Chapter Device and in the course menu there is content from the Desamind Chapter Device and there are also additional features such as chatbots, (6) content: this content menu contains learning materials from reference sources in the form of videos and modules in document format compiled by Desamind leadership training facilitators, as well as assignments and quizzes that must be completed by users (7) Chatbot: this chatbot menu contains a chatbot feature by implementing artificial intelligence technology. The feasibility of this platform was assessed through validation involving black-box testing, two media experts, two material experts, as well as compatibility testing and user trials. The functionality (black-box) test involved one software engineering expert. The media expert test was conducted by two lecturers from the Informatics Engineering Education Study Program at Muhammadiyah University of Surakarta, while the material expert test involved two Desamind facilitators. The user trial was conducted by 30 training participants who were part of the Desamind Chapter.

The analysis of the questionnaire conducted by expert validators and respondents yielded several important findings, namely (1) black-box testing, covering 37 test scenarios across the Admin, Teacher, and Student interfaces and conducted by one software engineering expert, showed a success rate of 100%. (2) Validation by E-Learning media experts using the Likert scale yielded a score of 93.75%, which falls into the "Very Feasible" category. (3) Validation by material experts using the Guttman scale method showed results with an interval score of 100%, which falls into the "Valid" category. (4) User trial results using the System Usability Scale (SUS) calculation showed an average score of 75.75 (SD = 11.14), which falls into the "B" category and is declared "Acceptable", although 40% of respondents fell in the Marginal band, driven mainly by first-use learnability items (see Table 8 and the item-level discussion above).

Based on these test results, it can be concluded that the Local Heroes School E-Learning, as a Moodle-based leadership learning platform with a chatbot feature, is a suitable learning medium for use at Desamind Indonesia's Local Heroes School. These findings align with research conducted by Marikar & Jayarathne (2016), which showed that the use of Moodle-based e-learning at Sir John Kotelawela Defence University, Sri Lanka, received positive feedback from its users and demonstrated that the Moodle-based e-learning platform can significantly improve student learning outcomes. Furthermore, this study is consistent with findings by Hidayat et al. (2022), whose usability evaluation of an educational chatbot using the System Usability Scale confirmed that chatbot-integrated systems are accepted by users and function effectively as learning support tools. Additionally, a statistical analysis of SUS evaluations on online learning platforms conducted by Suria (2024) reported a mean SUS score of 71.52, which similarly falls within the acceptable category, further reinforcing the validity of the SUS score of 75.75 obtained in this study. Therefore, the results of this study indicate that the Moodle-based Local Heroes School platform, inclusive of its chatbot feature, is broadly accepted by its intended users and provides a more structured and flexible learning experience than the platform's previous Zoom-and-WhatsApp-based workflow. Because the platform was evaluated holistically, however, these results should not be read as isolating the specific contribution of the chatbot component to this effect, for reasons elaborated below. This study has several methodological limitations that should be considered when interpreting its results and that open opportunities for future research. First, the SUS instrument used in the user trial evaluated the Local Heroes School platform as a whole rather than the chatbot's conversational quality specifically; a generic system-usability score is therefore not sufficient evidence that the chatbot itself is effective, and instruments such as the Chatbot Usability Questionnaire (Holmes et al., 2019) are recommended for future work that seeks to evaluate the chatbot as a standalone contribution. Second, this study did not include a controlled comparison between the Moodle platform alone and the Moodle platform integrated with the chatbot, so the incremental benefit attributable to the chatbot specifically cannot be established from the present data; a between-subjects or before-after comparison design is recommended for future work, noting that such work would require a new deployment, as the pilot platform used in this study is no longer active. Third, the chatbot's response quality was assessed only through the black-box testing scenarios reported in Table 5 rather than through a dedicated question-answering evaluation, and this could not be expanded retrospectively because the chatbot implementation is no longer active; future work should construct a structured dataset of representative leadership questions, covering both in-scope and out-of-scope queries, against which a redeployed chatbot's response accuracy and relevance can be systematically scored. Fourth, the specific large language model underlying the FastBots.ai chatbot at the time of implementation could not be independently determined by the researchers, since FastBots.ai did not provide a model-selection option during the study period; this option was introduced only after the research had been conducted and was therefore not used in this study's implementation. Consequently, the present results should be understood as an evaluation of the FastBots.ai-based chatbot implementation under the configuration used at the time of the study, rather than as an evaluation of the performance of any specific underlying language model. Beyond these methodological points, future studies could also focus on expanding the leadership material database to provide more comprehensive learning content, improving server infrastructure to support higher concurrent access under varying network conditions, and refining the chatbot interface branding to better align with the platform's identity. Longitudinal studies assessing the long-term impact of this platform on the actual leadership competencies of village youth would likewise contribute valuable insights to the field of community-based digital learning.

4. CONCLUSION

This research successfully developed a Moodle-based Local Heroes School E-Learning platform integrated with a chatbot feature as a leadership learning medium for village youth. The development was carried out through the four stages of the 4D model, namely Define, Design, Develop, and Disseminate, with the Disseminate stage in this study limited to hosting the platform and a pilot implementation trial. The results of the validity test involving media experts, material experts, and system testing through black-box testing showed that the developed platform was declared valid and suitable for use. In addition, the results of user trials involving 30 respondents from the Desamind Chapter Device members showed a good level of usability, with an average System Usability Scale (SUS) score of 75.75 (SD = 11.14), included in the acceptable category, although item-level analysis indicated that first-use learnability remains an area for improvement. These findings indicate that the Local Heroes School E-Learning platform is a feasible digital learning medium to support the development of village youth leadership, while also contributing to the development of e-learning-based learning models that are relevant to the context of youth empowerment at the community level. However, this study has several limitations, including difficulty in finding relevant leadership materials, accessibility issues when the platform is accessed simultaneously under unstable internet conditions, the appearance of the "Fastbot" label on the chatbot interface that needs to be refined to better align with the platform's branding, and as discussed above the absence of a chatbot-specific evaluation instrument and of a controlled comparison between Moodle alone and Moodle with the integrated chatbot. Therefore, future researchers are advised to conduct a more comprehensive evaluation of the platform, particularly in addressing these limitations such as improving server accessibility, expanding the leadership material database, refining the chatbot interface, and evaluating the chatbot's contribution specifically and at greater scale, while the Desamind Local Heroes School management is encouraged to continuously innovate in presenting learning content to create a more interactive and effective learning experience for village youth.

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CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

DATA AVAILABILITY

The data that support the findings of this study are available from the corresponding author upon reasonable request.

AUTHOR CONTRIBUTIONS

Rike Nursafitri: Conceptualization; Methodology; Investigation; Formal analysis; Software; Writing - Original Draft. Hardika Dwi Hermawan: Conceptualization; Supervision; Validation; Writing - Review & Editing. Ahmad Zahy Rashad Handradika: Data Curation; Investigation; Translation. Zakky Muhammad Noor: Validation; Writing - Review & Editing. Taufik Probawasito: Methodology; Development of Learning Media; Validation; Writing - Review. Dias Aziz Pramudita: Investigation; Validation; Writing - Review & Editing. Rochman Hadi Mustofa: Investigation; Data Curation; Validation; Writing - Review & Editing.

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