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Preliminary Changes in Flood Preparedness Following the PREPARE-BANJIR Chatbot: A One-Group Pretest–Posttest Study

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ABSTRACT

Background: Flood-prone communities need accessible education that supports preparedness and collective action. Evidence on chatbot-supported flood education in community settings remains limited.

Purpose: To assess changes in flood-related knowledge, attitudes, and mitigation practices following PREPARE-BANJIR chatbot use, describe participant engagement, and document the initial formation of community flood-response groups.

Methods: A pre-experimental, one-group pretest–posttest study involved 150 residents purposively recruited from flood-prone communities along the Brantas River in Kediri Regency, Indonesia. The intervention comprised six chatbot-based educational modules. Outcomes were assessed using a 48-item questionnaire, while engagement was documented through usage logs. Paired changes were analyzed using Wilcoxon signed-rank tests for knowledge and attitudes and a paired-samples t-test for mitigation scores.

Results: Mean knowledge scores increased from 7.79 to 9.93, with a mean change of 2.14 (95% CI: 1.86–2.42). Attitude scores increased from 41.79 to 46.97, with a mean change of 5.18 (95% CI: 4.43–5.93), and mitigation scores increased from 18.55 to 23.73, with a mean change of 5.18 (95% CI: 4.42–5.94). All paired comparisons were statistically significant ($p < 0.001$). Overall, 79.3% of participants completed all modules. Five flood-response groups, each comprising 30 members, were established.

Conclusion: PREPARE-BANJIR use was followed by improved preparedness-related scores and the establishment of community response groups. These preliminary findings warrant controlled evaluations to determine intervention effectiveness and the sustainability of individual and group outcomes.

Keywords **:** Chatbot; Community-Based Nursing management; Disaster Preparedness; Flood Mitigation; Health Education

BACKGROUND

The Kediri context further reinforces this need. A spatial analysis in Kediri City found that 64.62% of the area was classified as having high flood susceptibility and 16.08% as having

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very high susceptibility. These findings support non-structural mitigation through spatial planning, risk information, evacuation routes, and improved community preparedness (Tyas et al., 2022). At the national level, disaster preparedness in Indonesia continues to face gaps in knowledge, risk-analysis capacity, information-system integration, and continuity of community education (Ayuningtyas et al., 2021).

Disaster education is an important component in shaping knowledge, risk perception, attitudes, and protective actions. Experience of a disaster may promote learning, but experience alone does not necessarily result in adequate preparedness. Education helps individuals anticipate hazards and take preventive action, including those who have not previously been affected (Hoffmann & Muttarak, 2017). Research among university students also indicates that preparedness indicators are associated with disaster-risk awareness (Patel et al., 2023). Recent reviews emphasize that community-based education, school-based programs, simulation, local knowledge, and innovative approaches can strengthen capacity and resilience, although the quality of evaluation designs remains variable (Fu & Zhang, 2024; Guo et al., 2025; Juhadi et al., 2021; Mutch, 2023; Rizal et al., 2025; Shaw et al., 2021; Torani et al., 2019).

Chatbots provide an educational channel that can be accessed on demand, deliver content progressively, provide feedback, and record user engagement. Systematic reviews suggest that conversational agents can support education and health-related tasks, although evidence regarding effectiveness, safety, and methodological standardization remains limited (Laranjo et al., 2018; Milne-Ives et al., 2020; Schachner et al., 2020; Tudor Car et al., 2020). Content personalization, feedback, and recommendations may improve satisfaction and engagement, although their direct effects on outcomes require specific evaluation (Kocaballi et al., 2019). Artificial intelligence-based chatbots may also support health behavior change through personalized, on-demand interaction (Aggarwal et al., 2023). A study of health-literacy education found that chatbots can be used as an educational medium and are acceptable to users, suggesting that a similar concept may be relevant to disaster literacy (Mokmin & Ibrahim, 2021).

PREPARE-BANJIR was developed as a pre-disaster educational chatbot integrating six learning modules with dialogue-based interactions. The model is intended to support flood-resilient communities by improving knowledge, attitudes, and mitigation practices. However, before wider implementation, structured evaluation is needed to assess changes in outcomes and patterns of user engagement.

This study addresses the limited integrated evidence on changes in individual preparedness outcomes, chatbot engagement, and early community organization following a single pre-disaster digital education program. Its relevance to community nursing lies in structured risk communication and preparedness support. The objective was to assess paired changes in knowledge, attitudes, and mitigation, their association with chatbot use, and the initial formation of flood-response groups.

METHODS

Design and Setting

This study employed a pre-experimental one-group pretest–posttest design among 150 community members in flood-prone areas along the Brantas River in Kediri Regency, Indonesia.

Research activities were conducted from 17 June to 3 August 2026. The analysis used paired observations from the PREPARE-BANJIR study.

The documented study framework comprised recruitment and participant orientation, baseline assessment, access to the PREPARE-BANJIR chatbot and its six learning modules, recording of session frequency and module completion, post-intervention assessment, and initial organization/evaluation of five community Flood Disaster Response Groups (KTBs). The learning package specified interactive chatbot prompts, formative quizzes, scenario-based decisions, and practical checklists. Formative learning quizzes were intended to be separate from the research pretest/posttest questionnaire (PREPARE-BANJIR Research Team, 2026b).

Participants and Sampling

Purposive sampling was used to recruit 150 community members residing in flood-prone areas along the Brantas River in Kediri Regency, Indonesia. The principal inclusion criterion was residence in a community at risk of flooding near the river. The study enrolled 150 participants, all of whom had paired pretest–posttest data.

Instruments and Data Collection

The questionnaire development report provides the following internal-consistency coefficients for the 48-item instrument: knowledge (15 items), Cronbach's alpha = 0.837; attitudes (15 items), Cronbach's alpha = 0.867; and flood mitigation (18 items), Cronbach's alpha = 0.891 (Table 2). All three coefficients exceed the conventional 0.70 threshold. These coefficients were calculated from empirical pilot-response data and provide evidence of the internal consistency of the three questionnaire domains.

The study was conducted from 17 June to 30 August 2026. The PREPARE-BANJIR curriculum, version 1.1, dated 18 August 2026, describes six educational modules. Intervention exposure was documented through chatbot usage logs, including the number of access sessions and module completion. Active use was defined as completing at least 80% of the modules, completing at least three interactions, and accessing the chatbot on at least two separate days.

The PREPARE-BANJIR questionnaire comprises 48 items across three domains. Knowledge (15 dichotomous items; correct = 1, incorrect or unanswered = 0; possible score 0–15) covers flood risk and causes, early warnings, family preparedness, evacuation, health protection, and community response. Attitudes (15 four-point Likert items, with reverse coding for negatively worded statements; possible score 15–60) cover risk perception, information verification, family preparedness, evacuation, health protection, and participation. Flood mitigation (18 items scored not undertaken = 0, planned = 1, completed = 2; possible score 0–36) assesses planning, communication, evacuation, logistics, health preparedness, and community action. Higher scores indicate more favorable preparedness-related responses. These instrument specifications were extracted from the PREPARE-BANJIR questionnaire development report (PREPARE-BANJIR Research Team, 2026a).

Table 1. Questionnaire domains and scoring specifications

Domain	Items / range	Scoring	Indicators
Knowledge	15 / 0–15	Correct 1; Other 0	Risk, warnings, family, evacuation, health, community

Domain	Items / range	Scoring	Indicators
Attitudes	15 / 15–60	Likert 1–4; reverse-coded negatives	Risk perception, verification, family, evacuation, health, participation
Flood mitigation	18 / 0–36	Not done 0; planned 1; completed 2	Planning,communication, evacuation, logistics, health, community

Table 2. Reported questionnaire internal-consistency coefficients

Variable	Number of items	Reliability method	Reported coefficient
Knowledge	15	Cronbach's alpha	0.837
Attitudes	15	Cronbach's alpha	0.867
Flood mitigation	18	Cronbach's alpha	0.891

The educational content was organized into six chatbot modules: (M1) Understanding Floods and Local Risks—flood definitions, causes, health and social impacts, local risk, and myths versus facts; (M2) Early Warning and Danger Signs—official information sources, warning interpretation, environmental indicators, and misinformation verification; (M3) Home and Family Preparedness—family plans, emergency bags, documents, regular medications, and support for people requiring assistance; (M4) Safe Evacuation—when to evacuate, safe decisions, and officially verified routes and assembly points; (M5) Health and Initial Assistance—water and sanitation, wounds, electrical hazards, and seeking professional care; and (M6) Flood Disaster Response Groups—group roles, communication, resources, and drills. Learning activities included formative quizzes, source-selection simulations, household checklists, evacuation scenarios, safety quizzes, and selecting community roles (PREPARE-BANJIR Research Team, 2026b).

Data Analysis

Respondent characteristics, chatbot exposure, score categories, direction of change, and KTB outcomes were summarized using frequencies, percentages, means, standard deviations, ranges, and 95% confidence intervals when available. Normality of the change scores was assessed using the Shapiro-Wilk test. Because changes in knowledge and attitude scores were not normally distributed, paired comparisons were performed using the Wilcoxon signed-rank test. Changes in flood-mitigation scores were normally distributed and were analyzed using a paired t-test.

Ethical Considerations

Ethical review was conducted by the Research Ethics Committee of Universitas STRADA Indonesia. The study was conducted with attention to voluntary participation, informed consent, and confidentiality.

RESULTS

Respondent Characteristics

Most respondents were women (56.0%), were aged 36-45 years (30.0%), and had completed senior high school or equivalent education (40.7%). A total of 81.3% had previously

experienced flooding, whereas 78.7% had never participated in flood training or simulation (Table 3).

Table 3. Respondent characteristics (n=150)

Characteristic	Category	n	%
Sex	Male	66	44.0
	Female	84	56.0
Age	18-25 years	18	12.0
	26-35 years	35	23.3
	36-45 years	45	30.0
	46-55 years	32	21.3
	≥56 years	20	13.3
Education	Elementary school/equivalent	24	16.0
	Junior high school/equivalent	44	29.3
	Senior high school/equivalent	61	40.7
	Higher education	21	14.0
Previous flood experience	Yes	122	81.3
	No	28	18.7
Previous flood training/simulation	Yes	32	21.3
	No	118	78.7

Chatbot Exposure and Engagement

The mean number of access sessions was 10.41 ± 3.01, with a range of 3-18 sessions. A total of 119 respondents (79.3%) completed all six modules and 132 respondents (88.0%) met the active-user criteria. All 150 pretest-posttest pairs were complete and retained in the analysis (Table 4).

Table 4. Summary of exposure to the PREPARE-BANJIR Chatbot

Indicator	Result	Notes
Number of access sessions	10.41 ± 3.01	Range: 3-18 sessions
Completed all 6 modules	119 (79.3%)	Based on usage logs
Met active-user criteria	132 (88.0%)	≥80% of modules; ≥3 completed interactions; active ≥2 days
Complete pretest-posttest data	150 (100.0%)	All pairs analyzed

Pretest–Posttest Outcomes

Mean scores for all three outcomes increased after the intervention. Expressed as percentages of the maximum possible scores, knowledge increased from 52.0% to 66.2%, attitudes from 69.6% to 78.3%, and flood mitigation from 51.5% to 65.9% (Table 5).

Table 5. Descriptive statistics for pretest and posttest scores

Variable	Pretest mean ± SD	Posttest mean ± SD	Mean change (95% CI)	% of maximum
Knowledge	7.79 ± 2.08	9.93 ± 2.45	2.14 (1.86-2.42)	52.0 → 66.2
Attitudes	41.79 ± 5.66	46.97 ± 6.74	5.18 (4.43-5.93)	69.6 → 78.3
Flood mitigation	18.55 ± 6.01	23.73 ± 7.71	5.18 (4.42-5.94)	51.5 → 65.9

Statistical Comparisons

Note. CI=confidence interval; SD=standard deviation.

The Shapiro-Wilk test showed that changes in knowledge and attitude scores were not normally distributed, whereas changes in flood-mitigation scores met the normality assumption. All comparisons showed statistically significant improvements ($p<0.001$). Cohen's dz values ranged from 1.09 to 1.23 and were classified as large effects in the study dataset (Table 6). Interpretation nevertheless takes into account the one-group design without a comparator.

Table 6. Normality tests and pretest-posttest score comparisons

Variable	Shapiro-Wilk W (p)	Test/statistic	p	Cohen's dz	Effect
Knowledge	0.967 (0.001)	Wilcoxon; W=186.0	<0.001	1.23	Large
Attitudes	0.980 (0.029)	Wilcoxon; W=587.5	<0.001	1.12	Large
Flood mitigation	0.991 (0.445)	Paired t-test; t=13.383	<0.001	1.09	Large

Note. Effect-size values are retained from the supplied summary; the calculation of Cohen’s dz for Wilcoxon comparisons requires verification against the paired raw data and statistical method. A one-group design does not support causal attribution.

Changes in Score Categories

The proportion of respondents in the high category increased for all outcomes. For knowledge, the high category increased from 4.0% to 27.3%; for attitudes, from 20.0% to 47.3%; and for flood mitigation, from 4.7% to 30.0%. Conversely, the proportion in the low category decreased for all three outcomes (Table 7).

Table 7. Distribution of score categories before and after the intervention

Variable	Category	Pretest n (%)	Posttest n (%)
Knowledge	Low	94 (62.7%)	41 (27.3%)
	Moderate	50 (33.3%)	68 (45.3%)
	High	6 (4.0%)	41 (27.3%)
Attitudes	Low	17 (11.3%)	7 (4.7%)
	Moderate	103 (68.7%)	72 (48.0%)
	High	30 (20.0%)	71 (47.3%)
Flood mitigation	Low	100 (66.7%)	59 (39.3%)
	Moderate	43 (28.7%)	46 (30.7%)
	High	7 (4.7%)	45 (30.0%)

Individual Direction of Change

At the individual level, scores improved in 80.0% of respondents for knowledge, 81.3% for attitudes, and 82.7% for flood mitigation. Although improvement was the predominant pattern, some respondents had unchanged or lower scores, particularly for attitudes (14.7% decreased) and flood mitigation (11.3% decreased) (Table 8).

Table 8. Direction of score change at the individual level

Variable	Improved	Unchanged	Decreased
Knowledge	120 (80.0%)	21 (14.0%)	9 (6.0%)
Attitudes	122 (81.3%)	6 (4.0%)	22 (14.7%)

Variable	Improved	Unchanged	Decreased
Flood mitigation	124 (82.7%)	9 (6.0%)	17 (11.3%)

Association Between Session Frequency and Outcomes

The number of chatbot sessions was positively and significantly correlated with changes in knowledge, attitudes, and flood mitigation. The strength of the associations was weak, with the largest coefficient observed for flood mitigation ($r=0.291$; $p<0.001$) (Table 9).

Table 9. Correlation between the number of chatbot sessions and score changes

Score change	r	p	Interpretation
Knowledge	0.225	0.006	Positive, weak, significant
Attitudes	0.216	0.008	Positive, weak, significant
Flood mitigation	0.291	<0.001	Positive, weak, significant

Note. Correlation coefficients are reproduced as reported; the original analysis output is required to determine whether Pearson's r or Spearman's rho was applied.

Initial KTB Evaluation

All 150 respondents were organized into five Flood Disaster Response Groups (KTBs), each comprising 30 members. No members were awaiting verification, and all groups were classified as active at the initial evaluation. Initial rubric scores ranged from 75.0% to 85.0% (Table 10).

Table 10. Initial evaluation of the Flood Disaster Response Groups

Group	Members	Pending verification	Initial rubric score	Status
KTB-01	30	0	75.0%	Active
KTB-02	30	0	78.5%	Active
KTB-03	30	0	80.0%	Active
KTB-04	30	0	82.5%	Active
KTB-05	30	0	85.0%	Active

The mean initial rubric score across the five KTBs was 80.2%. This finding indicates that the target for establishing community organizations was achieved at the initial stage; however, this evaluation cannot yet be used to infer the long-term sustainability of the groups.

DISCUSSION

The study showed a consistent pattern of improvement in knowledge, attitudes, and flood mitigation following use of the PREPARE-BANJIR Chatbot. Relative to the maximum possible scores, the absolute increases were 14.2 percentage points for knowledge, 8.7 percentage points for attitudes, and 14.4 percentage points for flood mitigation. All changes were statistically significant and had Cohen's dz values greater than 1.0. The shift in score categories and the predominance of improvement at the individual level further support the consistency of this pattern. In addition to individual-level changes, all 150 respondents were successfully organized into five KTBs that were active at the initial evaluation. Nevertheless, these effects cannot be interpreted as definitive causal evidence because the study did not include a control group.

Respondent characteristics revealed an important gap: 81.3% had experienced flooding, but only 21.3% had ever participated in training or simulation. Direct experience may increase awareness but does not automatically develop systematic preventive skills. Hoffmann and Muttarak (2017) showed that experience and education operate through different learning mechanisms; education supports anticipation and action before a disaster occurs. Thus, a chatbot may serve as a bridge between local experience and structured mitigation knowledge.

The improvement in knowledge is consistent with the role of chatbots as educational media that can deliver content progressively and allow repeated access. A health-literacy study by Mokmin and Ibrahim (2021) showed that chatbots can support education and technology acceptance. Reviews of conversational agents have also reported generally positive findings regarding effectiveness and usability, although the quality of evidence is uneven and safety and evaluation methods require further strengthening (Laranjo et al., 2018; Milne-Ives et al., 2020; Schachner et al., 2020; Tudor Car et al., 2020). In the context of behavior change, personalization, interactivity, feedback, and on-demand availability are mechanisms that may enhance engagement (Aggarwal et al., 2023; Kocaballi et al., 2019).

The increase in attitude scores was smaller in percentage-point terms than the increases in knowledge and flood mitigation. This may be partly explained by the relatively high baseline attitude score (69.6% of the maximum), leaving less room for improvement. In addition, attitudes are influenced by social norms, experience, trust in information sources, perceived benefits, and self-efficacy; meaningful attitude change often requires repeated reinforcement and social support rather than a single exposure to information. The finding that 14.7% of respondents had lower attitude scores also indicates a need to evaluate content relevance, interaction burden, language, and chatbot responses for specific user groups.

The improvement in flood mitigation is important because this outcome is more directly related to preparedness actions. Effective disaster education should connect information with practice, simulation, community structures, local context, and community knowledge (Fu & Zhang, 2024; Guo et al., 2025; Juhadi et al., 2021; Mutch, 2023; Rizal et al., 2025; Shaw et al., 2021; Torani et al., 2019). The formation of five KTBs, each comprising 30 members, provides a pathway for translating digital knowledge into collective capacity. Initial rubric scores of 75.0%-85.0%, with a mean of 80.2%, indicate initial organizational readiness but do not demonstrate long-term sustainability. PREPARE-BANJIR should therefore be integrated with field simulations, evacuation-route mapping, group work plans, support from village governments, community health centers (puskesmas), Regional Disaster Management Agencies (BPBD), and periodic evaluation.

A total of 79.3% of respondents completed all modules and 88.0% met the active-user criteria. This level of engagement indicates that most participants received adequate exposure to the intervention. The positive correlations between the number of sessions and score changes suggest an association between intensity of use and outcome changes, but coefficients of 0.216-0.291 indicate that these relationships were weak. Digital engagement is not simply a matter of access frequency; depth of use, attention, motivation, subjective experience, and context also influence outcomes (Nahum-Shani et al., 2022). Strategies such as personalized feedback,

reminders, ease of use, flexibility, and social support may help sustain engagement (Saleem et al., 2021).

The association between chatbot use and score changes may also be affected by self-selection: more motivated users may access more sessions while also being more ready to change. Therefore, a statistically significant but weak correlation does not demonstrate that additional sessions directly cause higher scores. Future studies could evaluate dose thresholds, module sequence, time on task, feature-level engagement, and potential moderators such as age, education, flood experience, and digital literacy.

Limitations

Strengths include complete paired pretest–posttest records for 150 respondents, assessment across knowledge, attitudes, and mitigation, and documentation of chatbot engagement and early community organization. The questionnaire-development report specifies a 48-item, three-domain instrument, and the educational package describes six structured modules. However, the only supplied psychometric report explicitly uses simulated expert ratings and simulated responses; its validity and reliability coefficients do not constitute evidence of empirical validation in this study. Verification of the original pilot data and expert reviews is necessary before psychometric claims can be made.

The one-group design without randomization or a comparator prevents causal attribution; changes could reflect history, repeated testing, maturation, or selection effects. Purposive sampling of 150 residents from flood-prone communities along the Brantas River may introduce selection bias and limits generalizability beyond similar settings. Recruitment dates and intervention timing require documentation. The six-module curriculum was supplied as a draft requiring expert and local review, and the implemented version has not been independently verified. The lack of documented empirical instrument-validation output creates measurement uncertainty. Chatbot engagement was observational, and the initial KTB evaluation does not establish long-term group sustainability.

Implications for Nursing Practice

For community nursing, chatbots may support repeated pre-disaster education, standardized messaging, identification of learning needs, and follow-up of at-risk groups. The Health Emergency and Disaster Risk Management framework places prevention, preparedness, readiness, response, recovery, multisectoral collaboration, and community leadership within a continuum of risk management (World Health Organization [WHO], 2019). Content should therefore use plain language, local examples, actionable illustrations, brief quizzes, and clear referral pathways when users require human assistance. Given the variation in respondents' educational backgrounds, the design should account for digital literacy and accessibility. Low-cost access options, downloadable materials, and support from community health volunteers or disaster response groups should be provided so that digital innovation does not widen existing inequities.

From a governance perspective, chatbot logs can be used to monitor module completion and identify topics that users frequently fail to understand. However, log collection should follow the principles of data minimization, transparency of purpose, user consent, secure storage, access

restriction, and clearly defined retention periods. The chatbot should also state its functional limitations, information sources, update dates, and escalation pathways to BPBD, community health centers, or emergency services.

Future studies should use controlled or quasi-experimental designs with comparable control groups, immediate and 1-3-month follow-up measurements, simulation-based skills assessment, and analyses stratified by age, education, flood experience, and digital literacy. KTB functioning should be evaluated longitudinally through communication continuity, implementation of work plans, drills or simulations, member participation, and activity documentation. Reporting should also follow guidance for digital interventions and address safety, privacy, and user acceptability.

CONCLUSION

Among 150 respondents with complete pretest-posttest data, use of the PREPARE-BANJIR Chatbot was followed by significant improvements in flood-related knowledge, attitudes, and mitigation, with large effect sizes. Most respondents showed individual score improvements, the proportion in the high category increased, and the number of sessions had a positive but weak association with score changes. All respondents were also organized into five active KTBs, with a mean initial rubric score of 80.2%. These findings support PREPARE-BANJIR as a component of community-based pre-disaster education that can be combined with organizational strengthening, field simulation, and ongoing facilitation. Because the study did not include a control group, causal conclusions should remain limited and should be confirmed through controlled studies and sustainability evaluations.

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AUTHOR CONTRIBUTIONS

Alfian Fawzi: Conceptualization, project administration, and supervision. **Aprin Rusmawati:** Methodology and formal analysis. **Solichudin:** Community engagement and disaster-preparedness coordination.

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest, whether financial or non-financial, that could have influenced the design, conduct, analysis, interpretation, or reporting of this study.

DECLARATION OF AI USE

During manuscript preparation, the authors used ChatGPT (OpenAI) to assist with English-language editing, restructuring the manuscript according to the journal template, and integrating reviewer feedback.

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