JISIP (Jurnal Ilmu Sosial dan Pendidikan)
Vol. 10 No. 1 Januari 2026
e-ISSN : 2656-6753, p-ISSN: 2598-9944
DOI: *10.36312/jisip.v10i1.9743/http://ejournal.mandalanursa.org/index.php/JISIP/index*

Integration of AI Chatbot Based on LLM 'GURU DIGITAL' to Improve Numeracy Literacy in 3T Elementary Schools

Muhamad Sadli[1], Supiandi[2], Muhammad Subeli[3]
[1]Pendidikan Guru Sekolah Dasar, Fakultas Pendidikan, Universitas Nahdlatul Ulama NTB
[2]Ekonomi Islam, Fakultas Ekonomi, Universitas Nahdlatul Ulama NTB
[3]Sistem Informasi, Fakultas Teknik, Universitas Nahdlatul Ulama NTB)

Article Info
Article history:
Received: 14 November 2025
Publish: 1 January 2026

Keywords:
Chatbot AI;
Large Language Model (LLM);
Literacy and numeracy;
Elementary School;
3T Areas

Abstract
This study examines the effectiveness of the integration of a Large Language Model (LLM)-based AI chatbot named 'GURU DIGITAL' in improving the numeracy literacy of elementary school students in the Frontier, Outermost, and Disadvantaged (3T) areas. Addressing the challenges of educational disparities and low numeracy achievement in the 3T areas, 'GURU DIGITAL' is designed with an adaptive learning module that integrates local Sasak content, creating a personalized and culturally relevant learning experience. The research method uses a mixed method approach that combines Research and Development (R&D) with Participatory Action Research. The results show that 'GURU DIGITAL' was successfully developed with high NLP accuracy and an engaging adaptive module. Implementation in the field showed enthusiasm from students and teachers. A quantitative impact evaluation revealed a significant increase in students' numeracy literacy in the experimental group ($p < 0.001$) compared to the control group, as measured by the Numeracy AKM. The proportion of students in the experimental group achieving the "Proficient" and "Advanced" categories increased drastically from 18% to 65%. Qualitatively, students and teachers reported high levels of satisfaction with 'GURU DIGITAL' due to its ability to provide easy-to-understand explanations, a fun learning environment, and personalized learning support. This study concludes that the integration of the 'GURU DIGITAL' LLM-based AI chatbot is a highly effective and potentially transformative innovation in improving numeracy literacy among elementary school students in the 3T (third-to-third) regions, while simultaneously leveraging local cultural contexts in the learning process. Recommendations include the replication and scalability of this model to ensure equitable access to quality education across the 3T (third-to-third) regions.

Corresponding Author:
Muhamad Sadli
Universitas Nahdlatul Ulama NTB
Email: muhamadsadli040414@gmail.com

1. INTRODUCTION

Low numeracy literacy in Indonesia, particularly in the 3T (outermost) regions, is a crucial issue hindering students' achievement of basic competencies. Based on data from the 2022 National Assessment, 61.45% of elementary school students in Indonesia have not achieved minimum numeracy competency, with the figure even higher in 3T regions like Lombok (68.3%) (Coordinating Ministry for Human Development and Culture, 2022). Meanwhile, access to qualified teachers in target areas is very limited, such as North Lombok, with a ratio of 1:125 (Wagino et al., 2022). This is exacerbated by the lack of

infrastructure to support digital learning. Numeracy literacy is fundamental to the development of 21st-century skills such as problem-solving and logic, which are crucial in the digital economy. Furthermore, the digital transformation of education promoted by the government through the Independent Curriculum has not fully addressed the challenges in remote areas.

According to Kusnandar (2018), only 23% of schools in the region have adequate access to digital learning platforms. (1–5) This creates a widening digital divide. Conventional solutions such as teacher training, also face geographical and budgetary constraints. Therefore, innovative solutions are needed that: (1) can be accessed without relying on a stable internet connection; (2) enable personalized learning; and (3) involve local communities for sustainability. AI chatbots were chosen as the solution because they are capable of providing real-time interactive learning support.

Based on preliminary research in 5 elementary schools in North Lombok (January 2025), 82% of respondents were more motivated to learn mathematics using interactive digital media. Collaboration with the Lombok Young Teaching Community is also an added value, as they have a network of volunteers who can facilitate technology adoption in the field. Therefore, this research is not only urgent to overcome the numeracy crisis, but also becomes a replicable model for strengthening digital literacy in other 3T areas, in accordance with the SDGs 4 agenda (Quality Education) and the priority of the 2020-2024 RPJMN in educational equality. (5-10) The urgency of the numeracy literacy crisis in rural areas of Indonesia is already at a serious level and has the potential to hinder the process of developing superior human resources.

Existing data shows that more than two-thirds of elementary school students in North Lombok do not meet basic numeracy competencies and continue to be low in teacher quality and have minimal access to technology, which occurs in the 3T area. If not immediately intervened, it will have an impact on the further disadvantage of young people in the 3T area, which will continue to widen the education gap and decline in Indonesia's competitiveness in the current digital era. This research is relevant to the government's national agenda, not only educational reform, such as digitalization through the Independent Curriculum, but also equal access to technology, thus strongly emphasizing the urgency of innovative solutions that can be implemented quickly and massively. This research aims to develop a personalized LLM-based AI chatbot 'DIGITAL TEACHER' to improve the numeracy literacy of elementary school students in 3T through a collaborative approach with the local community.

2. RESEARCH METHODS

This research adopts a mixed methods approach, combining Research and Development (R&D) and Participatory Action Research (PAR). The research design will follow an R&D cycle enriched with PAR principles at every stage, ensuring active stakeholder involvement in the development and implementation process.

The stages of this research are as follows namely this research was carried out in 4 main stages:

1. Needs Analysis Stage (with PAR approach)

   Diagnostic Survey: Conducted with 200 students in grades 3-5 and 30 teachers at 10 pilot elementary schools in North Lombok (a 3T area). The instrument used was the standardized Numeracy Minimum Competency Assessment (AKM). This data will be used to map students' initial numeracy literacy levels and identify areas of difficulty.

   Focus Group Discussion (FGD): With the Young Teaching Community and teacher representatives from pilot elementary schools, we mapped specific needs related to numeracy materials, classroom learning challenges, and student preferences for

learning media. This FGD will form the basis for determining the features and content of "DIGITAL TEACHER."

2. Diagnostic Survey Stage

   The study involved 200 students in grades 3-5 and 30 teachers at 10 pilot elementary schools in North Lombok (a 3T area). The instrument used was the standardized Numeracy Minimum Competency Assessment (AKM). This data will be used to map students' initial numeracy literacy levels and identify areas of difficulty.

3. Fokus Group Discussion (FGD)

   Collaborating with the Lombok Young Teaching Community and teacher representatives from pilot elementary schools to map specific needs related to numeracy materials, classroom learning challenges, and student preferences for learning media. This FGD will form the basis for determining the features and content of "DIGITAL TEACHER." Development (using R&D and PAR approaches)

   Indonesian-Sasak Language-Based NLP Algorithm Development: Using the Rasa Open-Source framework to build a Natural Language Processing (NLP) model capable of understanding and responding to questions in Indonesian and Sasak. This development involved linguists and AI experts.

   Local Content Integration: Development of adaptive numeracy learning modules relevant to the local Sasak context, including the use of case studies, cultural context, and Sasak language vocabulary in questions and explanations. The module design considers the principles of personalized learning.

4. Implementation Stage (with PAR approach)

   Controlled Trial: Conducted over 6 months in 5 partner elementary schools (150 students). Students will be divided into an experimental group (using a 'DIGITAL TEACHER') and a control group (conventional learning). Group allocation will be carried out using cluster random sampling.

   Hybrid Training for Teachers: Conducted for teachers at partner elementary schools, this course covers an introduction to AI concepts, how to use "DIGITAL TEACHER," and learning strategies that utilize technology. Microlearning modules will be used to facilitate the training.

5. Evaluation Stage (with R&D approach)

   Impact Evaluation: Using the standard Numeracy Minimum Competency Assessment (AKM) instrument at the end of the trial period to measure the increase in numeracy literacy in the experimental group compared to the control group.

   Usability and Satisfaction Evaluation: Through questionnaires, interviews, and observations of students and teachers who use ‘DIGITAL TEACHER’ to assess aspects of user experience, effectiveness, and acceptance of the chatbot.

   Quantitative data (AKM Numeracy results) will be analyzed using inferential statistical tests (e.g., t-test or ANOVA) to compare the average scores between the experimental and control groups.

   Qualitative data (focus group discussions, interviews, and open-ended questionnaires) will be analyzed using thematic analysis techniques to identify patterns, perspectives, and recommendations from participants. The method section contains the type of method or approach used, a description of the qualitative and/or quantitative data / Mixed Method / Classroom Action Research / R and D, and explains the data collection procedures and data analysis techniques.

3. RESEARCH RESULTS AND DISCUSSION

This research aims to integrate a Large Language Model (LLM)-based AI chatbot called 'GURU DIGITAL' to improve the numeracy literacy of elementary school students

in the 3T (third-third) region. A mixed-method approach combining Research and Development (R&D) with Participatory Action Research (PAR) was implemented through four main stages: needs analysis, development, implementation, and evaluation.

1. Results of the Needs Analysis Stage

   The needs analysis stage involves a diagnostic survey and Focus Group Discussion (FGD) to map initial conditions and specific needs.

   3.1.AKM Numeracy Diagnostic Survey:

   An initial diagnostic survey of 200 students in grades 3-5 and 30 teachers at 10 pilot elementary schools in North Lombok showed that 78% of students fell into the "Needs Special Intervention" and "Basic" categories for numeracy literacy based on the AKM Numeracy instrument. The most prominent areas of difficulty included understanding fraction concepts, mixed arithmetic operations, and solving contextual problems involving quantitative reasoning. Teachers also indicated a limited availability of interactive and locally relevant learning resources.

   3.2.FGD with the Lombok Young Teaching Community and Teachers:

   FGDs confirmed that students in the research area showed little interest in conventional numeracy learning. The need for adaptive, personalized learning media that utilize familiar languages (including Sasak) is high. The Lombok Young Teaching Community emphasized the importance of content oriented to students' everyday lives to increase relevance and motivation to learn.

2. Development Phase Results

   Based on the results of the needs analysis, the development of the ‘DIGITAL TEACHER’ chatbot was carried out with a focus on personalization and local adaptation.

   a. Creating an Indonesian-Sasak Language-Based NLP Algorithm:

      The development of an NLP model using the Rasa Open Source framework successfully created a model capable of understanding and responding to questions and instructions in Indonesian and common Sasak phrases. The comprehension accuracy rate reached 92% for Indonesian and 85% for the Indonesian-Sasak combination. This enabled more natural and familiar interactions for students in North Lombok.

   b. Local Content Integration and Adaptive Learning Modules:

      GURU DIGITAL has successfully developed 12 adaptive numeracy learning modules tailored to the elementary school curriculum and enriched with local Sasak content. For example, numeracy story problems use the context of local agriculture, calculating shopping at a traditional Sasak market, or measuring land area using local units. The adaptive system allows the chatbot to adjust the difficulty level of the questions based on student performance, provide hints or additional explanations if students are struggling, and provide repeated practice on concepts not yet mastered. The chatbot interface is designed to be attractive and easy to use for elementary school teachers and students.

3. Implementation Phase Results

   The implementation phase involves controlled trials and teacher training.

   a. 6-Month Controlled Trial:

      The trial was conducted in five partner elementary schools, involving 150 students (75 students in the experimental group using 'GURU DIGITAL' and 75 students in the control group using conventional learning). Students in the experimental group regularly used 'GURU DIGITAL' for 2-3 sessions per week, each lasting 45 minutes, under teacher guidance. Observations during this period showed increased student participation and enthusiasm in learning

numeracy in the experimental group. Students felt more comfortable asking questions to the chatbot than directly to the teacher when experiencing difficulties.

b. Hybrid Training for Teachers:

Fifteen teachers from five partner elementary schools participated in hybrid training (online and in-person) focused on utilizing "DIGITAL TEACHER" as a learning tool. The microlearning module proved effective in facilitating teachers' understanding of AI in education, chatbot operations, and strategies for integrating it into the curriculum. Ninety-five percent of teachers reported feeling more confident in utilizing this technology.

4. Evaluation Stage Results

Impact evaluation was conducted using the standard AKM Numeracy instrument, accompanied by usability and satisfaction evaluation.

a. Evaluation of the Impact of Improving Numeracy Literacy (AKM Numeracy):

Inferential statistical analysis (ANOVA) on the post-test scores of AKM Numeracy, controlling for pre-test scores, showed a significant difference between the experimental and control groups ($F(1, 147) = 28.75$, $p < 0.001$, $\eta p2 = 0.16$). The average post-test score of AKM Numeracy in the experimental group ($M = 72.3$, $SD = 8.9$) was significantly higher than that of the control group ($M = 60.5$, $SD = 9.4$). Quantitatively, the proportion of students in the experimental group who achieved the "Proficient" and "Advanced" categories increased from 18% to 65%, while in the control group, the increase was only from 15% to 30%. These results indicate that the use of 'DIGITAL GURU' has a positive and significant impact on improving students' numeracy literacy.

b. Usability and Satisfaction Evaluation:

A student satisfaction questionnaire showed that 90% of students were very satisfied or satisfied with the use of 'GURU DIGITAL'. The most appreciated aspects were the chatbot's ability to provide easy-to-understand explanations, the enjoyable learning atmosphere, and the ability to learn independently. Meanwhile, the questionnaire and interviews with teachers revealed that 'GURU DIGITAL' was very helpful in diversifying teaching methods, providing quick feedback to students, and reducing question correction time. Teachers also considered this chatbot an effective tool for motivating students and addressing numeracy learning difficulties individually. An aspect that needs improvement is the availability of modules for higher grade levels.

Observations showed that students in the experimental group demonstrated higher levels of learning independence and were less dependent on direct teacher guidance for basic numeracy concepts. Interaction with the chatbot also increased students' confidence in problem-solving.

4. CONCLUSION

The results of this study comprehensively demonstrate that the integration of an AI chatbot based on the LLM 'DIGITAL TEACHER' equipped with adaptive learning modules and local Sasak content significantly and effectively improves the numeracy literacy of elementary school students in the 3T (frontier and lower reaches) areas. This finding is supported by a significant increase in students' Numeracy AKM scores, high levels of student and teacher satisfaction, and the successful development of a multilingual NLP model. This innovation has great potential to address educational gaps in the 3T (frontier and lower reaches) areas and offers a relevant, adaptive, and culturally relevant learning model.

5. ACKNOWLEDGEMENT

Thanks are expressed to the Ministry of Higher Education, Science, and Technology, Directorate General of Research and Development, through the Director of Research and Community Service for the 2025 Fiscal Year. Thanks, are also expressed to the parties who assisted in the implementation of the research, namely Nahdlatul Ulama University of West Nusa Tenggara, LPPM UNU NTB, and many thanks to the research team members.

6. BIBLIOGRAPHY

KemenkoPMK. (2022). *Indonesia Emas 2045 Diwujudkan Oleh Generasi Muda* Kemenko PMK.

Kusnandar. (2018). Inovasi Pembelajaran Berbasis Tik Di. *Jurnal Teknologi Pendidikan*, *06*(02).

Wagino, W., Wakhinuddin, W., & Afnison, W. (2022). Program Pelatihan Analisa Kerusakan (Trouble Shooting) Pada Sistem Pengapian Konvensional Menggunakan Simulator Ignition System di SMK N 1 Kepulauan Mentawai. *Suluah Bendang: Jurnal Ilmiah Pengabdian Kepada Masyarakat*, *22*(1). https://doi.org/10.24036/sb.02090

Arif Rachman, Dkk. (2024). *Metode Penelitian Kuantitatif. kualitatif dan R&D*. Karawang: CV Saba Jaya Publisher.

Sumantri, M. S., & Rachmadtullah, R. (2016). The effect of learning media and selfregulation to elementary students' history learning outcome. *Advanced Science Letters*, *22*(12), 4104–4108. https://doi.org/10.1166/asl.2016.8140

Tambunan, H., & Napitupulu, E. (2016). Effectiveness of Interactive Multimedia Based Learning Model in Engineering Mechanics. *International Education Studies*, *9*(10), 155–162. https://doi.org/10.5539/ies.v9n10p155

Vaughan, T. (2011). *Multimedia Making it work ;8th Edition*. New York: McGraw-Hill.

Winarno, S., Muthu, K. S., & Ling, L. S. (2018). Impacts of m-DPBL Approach towards Computer Networks Teaching and Learning Process. *International Journal of Emerging Technologies in Learning (iJET)*, *13*(3), 207. https://doi.org/10.3991/ijet.v13i03.7944

Xia, C. (2018). Multimedia Teaching Platform Construction Based on Flash Interaction Technology for Gymnastics. *International Journal of Emerging Technologies in Learning (iJET)*, *13*(5), 224. https://doi.org/10.3991/ijet.v13i05.8441