Madrasah: Jurnal Pendidikan dan Pembelajaran Dasar
Volume 19 (1), 2026 (Page 01—12)
DOI: 10.18860/mad.v19i1.45495

Training on AI-Assisted Moodle Content Organization for Elementary School Teachers: An Evaluation of Reactions and Cognitive Learning Outcomes

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ABSTRACT
This study aims to evaluate the effectiveness of Artificial Intelligence (AI)-Assisted Moodle Content Organization Training on elementary school teachers' cognitive understanding (Kirkpatrick Level 2) and participants' satisfaction levels (Kirkpatrick Level 1). The study employed a pre-experimental One-Group Pretest-Posttest Design involving 16 elementary school teachers at SDN 1 Maguan and SDN 2 Maguan in Malang Regency. The intervention was conducted over 32 instructional hours (IH), combining 12 IH of face-to-face learning and 20 IH of asynchronous self-directed assignments on the Moodle system. Teachers were trained to create structured instructions on Google Gemini to generate HTML instructional content with child-friendly inline CSS styling, as well as AIKEN-format quiz packages embedded into Moodle. Data collection utilized identical pre- and post-training cognitive comprehension tests, as well as a 15-item Likert-scale satisfaction questionnaire. Data analysis employed the non-parametric Wilcoxon test, the Paired Samples t-test, Normalized Gain (N-gain), Cohen's d_z effect size, Spearman's rank correlation, and thematic analysis. The results of the study showed a significant increase in teachers' cognitive understanding, from a pre-test mean of 61.19 to 84.50 on the post-test (Z = -3.408; $p < 0.001$; $t(15)$ = -4.898; $p < 0.001$), with a gain score of 23.31, a large effect size (d_z = 1.22), and a moderate average N-gain (0.59). Participants' satisfaction ratings were classified as "Very Good" across all dimensions (M = 4.62; SD = 0.42; α = 0.941). The Spearman correlation test showed no significant linear relationship between satisfaction and cognitive improvement (r_s = 0.157; p = 0.575). Limitations of the study include the absence of a control group, a small sample size, and the presence of a ceiling effect on the cognitive test.

Keywords:
Kirkpatrick Evaluation, Google Gemini, Elementary School Teachers, Moodle, Content Organization

Received: Aug, 5th 2026
Accepted: Oct, 23rd 2026
Published: Nov, 9th 2026

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INTRODUCTION

Digital transformation in elementary education is a strategic pillar in achieving Sustainable Development Goal 4 (SDG 4), which focuses on ensuring the quality of inclusive and equitable education. The need to enhance educators' digital competencies is a crucial factor in ensuring that the learning process can dynamically adapt to technological advancements. In the context of continuous professional development, Desimone (2009)

emphasizes that high-quality Teacher Professional Development (TPD) programs must meet five core features: a focus on content, the incorporation of active learning, coherence with school needs and policies, an adequate duration (a minimum of 20 contact hours), and collective participation among teachers. The integration of these five pillars serves as an essential foundation for community service-based training interventions to make a tangible contribution to enhancing educators' capacity and conceptual mastery. This principle is further reinforced by Ahmmed et al. (2022), who state that training based on an analysis of teachers' actual needs has been shown to significantly and sustainably improve technological competence, self-efficacy, and the quality of online teaching. The integration of these pillars serves as an essential foundation for ensuring that community service-based training interventions can make a tangible contribution to enhancing educators' capacity and conceptual mastery.

One of the most flexible and widely used Learning Management System (LMS) platforms globally for managing digital learning is Moodle. Rooted in the philosophy of social constructivism, Gamage et al. (2022) explain in their systematic review that Moodle provides a variety of modular features that are effective in adaptively enhancing learners' engagement, performance, and monitoring of self-directed learning. This platform enables educators to upload instructional materials, assign tasks, manage interactive discussion forums, and design periodic assessment quizzes. Recent technological advancements have integrated Moodle with Artificial Intelligence (AI) technologies (Alonzo-Godoy et al., 2026; Kaleci, 2025). The integration of AI tools into the Moodle platform opens up significant opportunities for the automation of administrative tasks, the design of digital instructional materials, and the creation of a learning content management system that is more adaptive and responsive to students' needs (Kaleci, 2025).

Although the potential of LMS and AI technologies is immense, the reality on the ground often reveals a gap between the availability of physical infrastructure and the readiness of human resources. The actual conditions at the partner schools—SDN 1 Maguan and SDN 2 Maguan in Ngajum Subdistrict, Malang Regency—indicate that technology-supporting facilities are already available on school grounds, including adequate internet connectivity, Interactive Flat Panel (IFP) devices in classrooms, and a high rate of device ownership among students. However, the utilization of these ICT facilities for instructional activities has not been optimal due to the low digital literacy of the majority of teachers. Teachers' experience with online media at the partner schools has so far been limited to the basic operation of Google Classroom—a pattern consistent with Susanti's (2025) finding that the use of Learning Management Systems (LMS) in elementary schools is generally still limited to one-way distribution of materials due to teachers' limited technical skills. On the other hand, the school has planned to implement structured online learning over the next two to three years. To achieve this goal, the school needs a more feature-rich and diverse range of digital learning platforms to complement the existing learning ecosystem.

Efforts to train elementary school teachers in the use of the Moodle LMS have in fact been reported by several previous community service project implementers, such as the Moodle training for teachers at Muhammadiyah 1 Kesamben Elementary School conducted by Widianto et al. (2023), the online Moodle training for elementary and middle school teachers within the Christian Education Foundation by Trisno (2021), and the Moodle training for creative teachers by Agusta and Astriawati (2025). Suparjan et al. (2024) also confirmed that elementary school teachers view Moodle as highly beneficial as a supplement to in-person classes, but the effectiveness of its adoption is often hindered by the complexity of navigation and the preparation of digital content. These reports underscore that elementary school teachers generally face technical challenges and a heavy mental burden when operating Moodle's complex interface from scratch. Organizing class structures, uploading materials, and manually compiling question banks without technological support require a significant investment of time and often trigger resistance among teachers. Meanwhile, most of the recent literature on the integration of Moodle and AI still focuses on the realm of higher education (Alonzo-Godoy et al., 2026; Kaleci, 2025). There has been no research-based community service study that specifically formulates training in Generative AI-assisted Moodle content organization for elementary school teachers with limited foundational ICT literacy. This empirical gap represents the primary area of contribution for this program.

To bridge this gap, this community service initiative designed an intervention in the form of an AI-Assisted Moodle Content Organization Training program lasting 32 Instructional Hours (IH). This training is supported by a practical e-module guide developed independently by the development team to facilitate asynchronous learning, as the provision of structured digital modules has proven effective in guiding self-directed mastery of the material and assignments for elementary school teachers (Rini & Solehah, 2021). Theoretically, this training adopts the AI-based Technological Pedagogical Content Knowledge (AI-TPACK) framework proposed by Mishra et al. (2023) and validated by Runge et al. (2025) as a key determinant that enhances teachers' perceptions of the usefulness of and acceptance toward intelligent technology. Within this framework, AI is positioned not as a replacement for the teacher's role, but rather as an intelligent curation assistant in the dimensions of Technological Pedagogical Knowledge (TPK) and Technological Content Knowledge (TCK). Teachers are equipped with prompt engineering skills on Google Gemini to produce draft materials, assessment indicators, and child-friendly HTML code in inline CSS style that can be safely embedded into the Moodle text editor without requiring advanced coding skills. Based on Cognitive Load Theory (Sweller, 2020), the use of AI tools serves to reduce

extraneous cognitive load and simplify the complexity of technical element interactivity in Moodle, allowing teachers to shift their mental focus toward making contextual pedagogical decisions.

The success of this community service training program was scientifically evaluated using the Kirkpatrick and Kirkpatrick (2016) training evaluation framework. The evaluation focused on the first two levels relevant for measuring the direct impact of the intervention: Level 1 (Reaction), to assess participants' perceptions of satisfaction with the training, and Level 2 (Learning), to measure teachers' cognitive understanding. Based on the problem statement and gap analysis, this study aims to answer two research questions: (1) What are elementary school teachers' perceptions of satisfaction (Kirkpatrick Level 1) regarding the implementation of AI-assisted Moodle content organization training, as assessed in a structured manner across the dimensions of instructor quality, materials, and organizers?; and (2) To what extent did the cognitive learning outcomes of elementary school teachers (Kirkpatrick Level 2) improve after participating in this training series, as measured by a comparison of pre-test and post-test scores? Through this research-based community service approach, the results of this activity are expected to provide a proven training model for elementary schools in preparing for the implementation of online learning in the future.

METHOD

Research Design and Subjects

This study employed a quantitative approach supplemented by descriptive analysis, using a pre-experimental One-Group Pretest-Posttest Design. The evaluation was conducted using multiple instruments that combined cognitive tests and satisfaction questionnaires, replacing the term "instrument triangulation." The research subjects comprised the entire population of teachers at SDN 1 Maguan and SDN 2 Maguan, Ngajum Subdistrict, Malang Regency, with a total of 16 teachers (N=16). In general, the participants' initial ICT literacy was limited to Google Classroom and instant messaging, with no experience in web programming. The lack of detailed demographic data (such as age and years of service) was acknowledged as a limitation of the study's initial data.

Training Procedure

The training will be held in July 2026 and will last 32 instructional hours (IH), divided into 12 IH of face-to-face (synchronous) sessions and 20 IH of guided independent assignments (asynchronous). The sessions are led by a resource person—a professor of Educational Technology from Malang State University (UM)—as the primary presenter, assisted by undergraduate students majoring in Educational Technology as technical facilitators. The structure of the training material is presented in Table 1.

Table 1. Time Allocation and Training Material Structure

No	Training Material	Time Allocation	Learning Mode
1	Developing Elementary School Instructional Designs	4 IH	Asynchronous / online
2	Developing 3 Types of Assessment (AoL, AfL, AaL) for Elementary School Instruction	4 IH	Asynchronous / online
3	Basic Concepts of Learning Management Systems (LMS)	2 IH	Asynchronous / online
4	Introduction to and Navigation of the Moodle Platform	2 IH	Synchronous / In-Person
5	Exploration of AI Tools & Prompting for Learning	4 IH	Asynchronous / Online
6	Practical Integration of Content & Assessments into AI-Based Moodle	12 IH	Synchronous & Asynchronous
7	Review & Evaluation of Digital Classes on Moodle	4 IH	Synchronous / In-Person

Source: Researcher

The operationalization of AI adopts the AI-TPACK framework by utilizing Google Gemini, which is accessed externally via a web browser. Teachers are trained to use structured instructional formulas to create child-friendly, inline CSS-based materials ready to be embedded into the Moodle text editor. The AI prompt formulas taught are:

> "Serve as a Senior Front-End Web Developer and Instructional Designer specializing in the Moodle LMS. Your task is to create plain HTML code with styling (inline CSS) to be embedded in the 'CORE LEARNING' section of Moodle.
> [PARAMETERS]: Grade Level: Elementary School; Subject: Science—Solar System; Structure: 1 Stage (Exploration & Observation of Planets); Media: Illustrations and links to educational videos.
> [DESIGN & UI GUIDELINES]: Layout style: Playful & Fun Soft Cards (elementary school-friendly); Primary accent color: #1f62ff; Visual elements: Stage number badges, separate instruction cards, callouts for important tips, soft rounded corners (rounded-xl), and soft shadows; Language: Communicative and motivating.
> [MOODLE TECHNICAL REQUIREMENTS]: Must be 100% inline CSS (style='...'), external <style> tags are prohibited, no JavaScript (<script>), responsive layout (desktop & mobile), and quizzes/videos must be embedded directly via iframe.
> [OUTPUT FORMAT]: Provide ONLY ready-to-use HTML code within a Markdown code block without the <html>, <head>, or <body> tags."

The training is supported by self-paced e-modules that serve as scaffolding to reduce extraneous cognitive load. An AI ethics curriculum is also incorporated, covering factual verification to mitigate text hallucinations and ensuring compliance with elementary school students' data privacy regulations.

Data Collection

Data collection focused on Levels 1 and 2 of the Kirkpatrick & Kirkpatrick (2016) model. Cognitive Learning Outcomes (Level 2): Measured using identical pre-tests and post-tests administered before and after the training. The test consists of 10 multiple-choice items (weighted 8 per item; subtotal 80) and 2 essay items (weighted 10 per item; subtotal 20) with a score range of 0–100. The test was designed to measure mastery of the training material and has not yet undergone expert validation or preliminary reliability estimation, which is acknowledged as a limitation of the test instrument. The item mapping is presented in Table 2.

Table 2. Instrument Blueprint for Assessing Teachers' Cognitive Understanding (Kirkpatrick Level 2)

No	Assessment Instrument	Format	Weight
1	Distinguish the architectural design of an LMS from that of cloud storage and communication applications.	MCQ	8
2	Analyze the functional relationship between the Assessment and Report components.	MCQ	8
3	Examine the scope of authority for Administrators and Teachers.	MCQ	8
4	Identify the implications of integrating third-party applications into an LMS.	MCQ	8
5	Analyze a comparison of the flexibility of Moodle and Google Classroom.	MCQ	8
6	Explain Moodle's philosophy of social constructivism in learning.	MCQ	8
7	Explain the function of the Data Directory in Moodle storage.	MCQ	8
8	Identify the features of learning resources that allow for the direct insertion of text and images.	MCQ	8
9	Distinguish between the characteristics of Workshop activities and Assignments.	MCQ	8
10	Explain the function of the Activity Completion tracking feature.	MCQ	8
11	Describe the four main functions of a Learning Management System (LMS).	Essay	10
12	Describe the three main components of the assessment and reporting ecosystem in Moodle.	Essay	10

Source: Researchers

Essay responses were scored using an analytical rubric with an even-numbered scale (2, 4, 6, 8, 10) based on conceptual accuracy, as summarized in Table 3.

Table 3. Essay Question Scoring Rubric (Maximum Score of 10 per Item)

Score	Criteria for Evaluating the Accuracy of Answers
10	The answer is accurate, complete, and covers all components of the concept as requested.
8	The answer is accurate and covers most of the conceptual components with a concise explanation.
6	The answer is fairly accurate but includes only half of the core conceptual components.
4	The answer is less accurate and mentions only a small portion of the conceptual components.
2	The answer is inaccurate or contains only an incorrect introductory idea.

Source: Researcher

Participant Satisfaction Perception (Level 1): Measured post-training using a 15-item questionnaire on a 1–5 Likert scale across three aspects: Instructor (items 1–5), Content (items 6–10), and Organizing Committee Performance (items 11–15). The questionnaire's reliability was very high, with a Cronbach's Alpha of α=0.941. Satisfaction categories include: 1.00–1.80 (Very Low), 1.81–2.60 (Low), 2.61–3.40 (Fair), 3.41–4.20 (Good), and 4.21–5.00 (Very Good). Of the 16 participants in the cognitive test, 15 teachers (N=15) completed the questionnaire in full, as one participant was unable to attend at the conclusion of the study; this case was handled using complete case analysis. The questionnaire included two open-ended questions (suggestions for improvement and memorable experiences), which were analyzed using the six-step thematic analysis framework proposed by Braun & Clarke (2006).

Data Analysis

Descriptive statistics were calculated using the sample variance formula (n-1) for the mean and standard deviation (SD) of the pre-test, post-test, and gain scores. The Shapiro-Wilk normality test on the gain score data (N=16) yielded a value of W=0,881; df=16; p=0,040 (p<0,05), indicating a non-normal distribution. Therefore, the appropriate primary comparison test is the nonparametric Wilcoxon Signed-Rank Test, supplemented by the Paired Samples t-Test as a supporting parametric confirmation.

The effect size of the intervention was calculated using Lakens's (2013) paired-design formula for the values of d_z, d_{av}, and Hedges' u g_{av}, small-sample bias correction, which were interpreted according to Cohen's (2013) criteria: |d|< 0,20 (very small), 0,20 ≤|d|<0,50 (small), 0,50 ≤|d|< 0,80 (moderate), and |d|≥ 0,80 (large). The effectiveness of the increase was analyzed using Hake's (1998) Normalized Gain (N-gain) formula, with the following categories: Low (< 0.30), Moderate (0.30 ≤ ⟨g⟩ < 0.70), and High (≥ 0.70), as well as identifying

potential ceiling effects when scores cluster at the upper limit of the test. The relationship between satisfaction scores (Level 1) and learning outcomes (Level 2) was tested using Spearman's rank correlation (r_s) on 15 respondents with complete data. A paired individual slope graph was presented to fully display the dynamics of the participants' actual empirical scores.

RESULTS AND DISCUSSION

The AI-Assisted Moodle Content Organization Training for Elementary School Teachers at SDN 1 Maguan and SDN 2 Maguan was conducted in a structured manner with a total allocation of 32 Instructional Hours (IH), combining 12 IH of synchronous face-to-face sessions (synchronous) and 20 IH of guided independent assignments (asynchronous) via the Moodle server provided by the service-learning team. The program was evaluated based on the Kirkpatrick & Kirkpatrick (2016) training evaluation model, which includes an assessment of cognitive learning outcomes (Level 2) and participants' satisfaction (Level 1).

Teachers' Cognitive Learning Outcomes (Kirkpatrick Level 2)

Teachers' cognitive understanding was assessed using test instruments administered before (pre-test) and after (post-test) the training. The pre-test and post-test items were identical, consisting of 10 multiple-choice items (weighted 8 per item; subtotal 80) and 2 essay items (weighted 10 per item; subtotal 20) with a score range of 0–100. Empirical data on individual scores from 16 teachers (N=16) are presented in Table 4.

Table 4. Data on Pre-Test Scores, Post-Test Scores, Gain Scores, and Individual Normalized Gains of Participants

Participants	Pre-Test	Post-Test	Gain	N-Gain	N-Gain Category
Participation 1	42	58	16	0,276	Low
Participation 2	73	82	9	0,333	Moderate
Participation 3	42	98	56	0,966	High
Participation 4	51	98	47	0,959	High
Participation 5	75	90	15	0,600	Moderate
Participation 6	60	98	38	0,950	High
Participation 7	87	98	11	0,846	High
Participation 8	59	82	23	0,561	Moderate
Participation 9	70	98	28	0,933	High
Participation 10	77	82	5	0,217	Low
Participation 11	34	34	0	0,000	Low
Participation 12	46	98	52	0,963	High
Participation 13	77	82	5	0,217	Low
Participation 14	33	82	49	0,731	High
Participation 15	78	90	12	0,545	Moderate
Participation 16	75	82	7	0,280	Low
Mean	**61,19**	**84,50**	**23,31**	**0,59**	**Moderate**
Standard Deviation (SD)	**17,62**	**17,21**	**19,04**	-	-
Cohen's d_z	-	-	-	**1,22**	**Large**

Source: Researcher

Table 4 shows that the teachers' average cognitive understanding before the training was 61.19 (SD = 17.62), which then increased to 84.50 (SD = 17.21) after the training, with an average actual gain of 23.31 points (SD = 19.04). The group's mean Normalized Gain (N-gain) was 0.59 (or 0.60 when rounded), which falls into the "Moderate" effectiveness category according to Hake's (1998) criteria. The highest score increases were achieved by Participant 3 (gain = 56; N-gain = 0.966) and Participant 12 (gain = 52; N-gain = 0.963). However, individual variation was observed in Participation 11, which showed no increase in score (gain = 0; score remained at 34), as well as in Participation 10, 13, and 16, which showed limited increases ranging from 5 to 7 points. Additionally, six participants achieved a post-test score of 98, indicating a concentration of scores at the upper limit of the instrument (ceiling effect).

A Shapiro-Wilk test of normality for the gain score data yielded a W statistic of 0,881 with degrees of freedom (*df)* = 16 and a p-value (*p)* of 0,040. Since the $p < 0,05$, the gain score data are not normally distributed. Therefore, the nonparametric Wilcoxon Signed-Rank Test was used as the primary hypothesis test, yielding a Z = -3,408 with an Asymp. Sig. (2-tailed) $p < 0,001$.These results indicate that there was a statistically significant improvement in cognitive understanding after teachers completed the training. As supporting parametric confirmation, the Paired Samples t-Test yielded a $t(15) = -4,898$ with a significance level of $p < 0,001$.

The calculation of the effect size for the within-subjects design yielded a value of Cohen's d_z = 1,22. When calculated based on the mean of the standard deviations of the two test sessions, d_{av} = 1,34, was obtained, and with Hedges' small-sample bias correction, g_{av} = 1,27 was obtained. According to Cohen's (2013) standard

guidelines, this effect size falls within the "Large" effect category (|d|≥ 0,80). The changes in cognitive scores for all participants are presented in Figure 1.

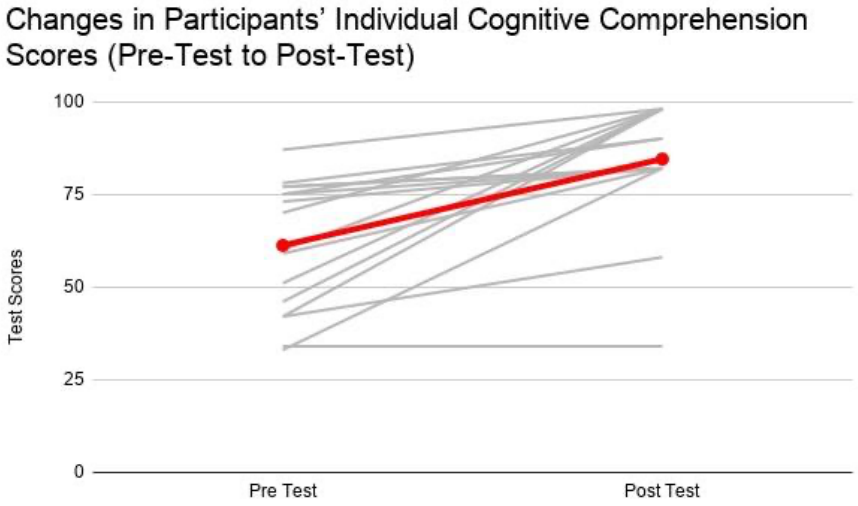


Figure 1. Paired Slopegraph of Individual Score Changes for Participants from the Pre-Test to the Post-Test

Participants' Perceived Satisfaction with the Training (Kirkpatrick Level 1)

Participants' reactions were assessed at the end of the training using a questionnaire consisting of 15 statements on a 1–5 Likert scale. Of the 16 participants in the cognitive test, 15 teachers (N = 15) completed the questionnaire in full, as one participant was unable to attend the closing session due to an official assignment outside the city. This missing data was treated as such through complete-case analysis. The instrument reliability test yielded a Cronbach's Alpha coefficient of α = 0,941, demonstrating a high level of internal consistency for the instrument. The results of the descriptive statistical analysis by satisfaction dimension are presented in Table 5.

Table 5. Summary of Descriptive Statistics by Satisfaction Dimension for Training Participants

Dimensions of Satisfaction	N	Minimum Score	Maximum Score	Mean	Standard Deviation (SD)	Category
Satisfaction with the Presenter	15	3,80	5,00	4,6267	0,46517	Very Good
Satisfaction with Course Content	15	3,80	5,00	4,5333	0,48206	Very Good
Satisfaction with the Organizing Committee	15	3,80	5,00	4,6933	0,41312	Very Good
Overall Satisfaction	**15**	**3,93**	**5,00**	**4,6178**	**0,41516**	**Very Good**

Source: Researcher

The data in Table 5 show that all dimensions of satisfaction fall into the "Very Good" category (score > 4.20). The Organizing Committee Satisfaction dimension received the highest mean (M = 4.6933; SD = 0.41312), followed by Presenter Satisfaction (M = 4.6267; SD = 0.46517), and Content Satisfaction (M = 4.5333; SD = 0.48206), with a total satisfaction score of M = 4.6178 (SD = 0.41516). Detailed statistics for each statement item are presented in Table 6.

Table 6. Item Statistics for the Participant Satisfaction Questionnaire

No	Aspects and Items of the Instrument	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
A	**Presenter Satisfaction Aspect**		
1	The presenter delivered the material in a way that was easy for me to understand during the session.	0,516	0,954
2	I felt that the instructor responded well to my questions and needs during the training.	0,804	0,935
3	The instructor created a learning environment that made me feel comfortable and actively engaged.	0,719	0,937
4	The instructor's mastery of the material gave me confidence in the content of the training.	0,719	0,937
5	The way the instructor related the material to real-world practice felt relevant to my work as a teacher.	0,851	0,933

No	Aspects and Items of the Instrument	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
B	**Content Satisfaction**		
6	The material presented in this training met my needs as a teacher in the field.	0,872	0,933
7	I was able to follow the flow of the training material well because the presentation was structured and easy to follow.	0,743	0,936
8	The depth and breadth of the material provided were sufficient to broaden my professional horizons.	0,671	0,938
9	I discovered new ideas or knowledge from this training material that I can immediately apply in the classroom.	0,646	0,938
10	This training material encouraged me to think more critically about developing my teaching practices in the future.	0,774	0,935
C	**Organizing Committee Performance Satisfaction**		
11	The information and guidance I received from the organizing committee before the training were clear and adequate.	0,679	0,937
12	The organizers were responsive and helpful whenever I needed assistance during the training.	0,680	0,938
13	I felt that the flow and schedule of the training activities were well-organized and proceeded according to the announced plan.	0,831	0,934
14	The organizers' communication with participants was friendly and professional throughout the training.	0,663	0,938
15	Overall, I am satisfied with how the committee managed and organized this training.	0,878	0,933

Source: Researchers

To test the relationship between satisfaction (Level 1) and cognitive learning outcomes (Level 2), a Spearman rank correlation analysis (r_s) was conducted between the Total Satisfaction score and the cognitive gain score for 15 teachers with complete paired data. The test results showed a correlation coefficient of r_s = 0,157 with a significance level of p = 0,575. A p-value > 0,05 indicates that there is no statistically significant linear correlation between participants' level of satisfaction with the training and the magnitude of the cognitive score improvement achieved.

Analysis of Participants' Open-Ended Responses

A thematic analysis of the participants' open-ended responses at the end of the questionnaire was conducted following the procedures outlined by Braun & Clarke (2006). The results of the thematic synthesis are presented in Table 7.

Table 7. Results of the Thematic Analysis of Open-Ended Responses from Training Participants

Open-Ended Questions	Extracted Themes	Frequency	Examples of Participant Responses
Criticism and Suggestions: *Is there anything you think needs to be improved or enhanced in this training? Please provide specific criticism and suggestions.*	**Theme 1.1:** Overall satisfaction with the smooth running of the session and the facilitator's guidance.	8	*"It was very good.", "The training was good; the facilitator's explanations were easy to understand, and they patiently guided the teachers.", "It went very smoothly."*
	Theme 1.2: Need for more comprehensive summaries of the material in the guidebook.	1	*"The guidebook shared before the activity was very helpful; it would be even better if it included more summaries of the material."*
	Theme 1.3: Request for additional time allocated for hands-on practice.	1	*"The practical sessions should be made even more in-depth."*
	Theme 1.4: Hope for follow-up training and ongoing reinforcement.	2	*"The training that was held was quite good. My suggestion is that there should still be ongoing training on the use of this LMS," "I hope there will be a follow-up session to reinforce what we've learned about digital classrooms."*
Memorable Experience: Describe the most memorable experience you had during the training—whether it was something that inspired you, motivated you, or simply left a lasting impression on you.	**Topic 2.1:** Introduction to the Moodle platform as a new innovation in digital classroom management.	6	*"Moodle is something new I've tried since becoming a teacher. It makes managing the learning process easier and more interactive…," "The experience of opening Moodle for the first time and discovering its many features…," "Being able to explore Moodle's features."*
	Theme 2.2: Appreciation for the support provided by responsive, friendly, and patient instructors and facilitators.	4	*"The presenters and mentors were very responsive whenever a participant faced difficulties...", "The presentation was very satisfying, and the organizers were very friendly and patient in helping with difficulties during the training...", "Led directly by highly competent experts..."*

Open-Ended Questions	Extracted Themes	Frequency	Examples of Participant Responses
	Theme 2.3: Growing motivation to help students develop computer skills.	2	*"This experience inspired me to create a digital classroom to improve students' skills so they won't feel awkward using computer equipment," "I gained new knowledge that I can apply with my students."*

Source: Researchers

Analysis of Improvements in Teachers' Cognitive Understanding (Kirkpatrick Level 2)

The research findings demonstrate that the training intervention was associated with an increase in elementary school teachers' cognitive understanding of the basic concepts of LMS and AI-assisted Moodle content organization procedures. The increase in scores from a pretest mean of 61.19 to 84.50 on the post-test was found to be statistically significant via the Wilcoxon test (Z = -3,408; p < 0,001) and supported by a paired parametric t-test (t (15) = -4,898; p < 0,001). The paired effect sizes obtained (d_z = 1,22; d_{av} = 1,34) fall into the "Large" effect category according to Cohen (2013). The effectiveness of this cognitive improvement falls into the moderate category with a mean ⟨g⟩ = 0.59.

This improvement in cognitive understanding is supported by the integration of the AI-TPACK framework (Mishra et al., 2023), in which teachers are guided to use Google Gemini to create instructional materials for organizing thematic science content in HTML with inline CSS. As demonstrated by Hamza et al. (2025), the use of large language models has been shown to significantly improve teachers' motivation, time efficiency, and the quality of their instructional material preparation compared to conventional methods. Structured prompting formulas enable AI to function as an assistant for content design and the creation of AIKEN-format quizzes, thereby making it easier for teachers to upload instructional materials to Moodle. Drawing on Cognitive Load Theory (Sweller, 2020), the scaffolding provided by prompting guidelines and step-by-step E-Module guides successfully reduces extraneous cognitive load. This supportive phenomenon aligns with the concept of teacher-AI collaboration proposed by Faraji et al. (2026) as well as the optimization of Moodle's socio-pedagogical engagement described by Touis et al. (2024), where AI integration accelerates content curation without requiring advanced technical expertise, allowing teachers to focus their mental energy on mastering the navigation and pedagogical substance of the digital classroom.

These results are consistent with the findings of Surahman et al. (2024) who documented the effectiveness of a 32 IH ICT training program for elementary school teachers. These findings also confirm the results of studies by Widianto et al. (2023) at Muhammadiyah 1 Elementary School in Kesamben and Trisno (2021) within the YBPK network, which showed that elementary school teachers require phased training to be able to operate Moodle features. This AI-assisted training has been shown to help teachers develop instructional materials efficiently, as emphasized by Soelistijanto et al. (2026) and Kaleci (2025) regarding the effectiveness of integrating AI to enrich digital instructional materials.

Analysis of Participant Satisfaction Evaluation (Kirkpatrick Level 1) and Its Relationship to Learning Outcomes

The reaction evaluation indicated that participants' satisfaction perceptions fell into the "Very Good" category across all dimensions, with an average Total Satisfaction score of 4,6178 (SD = 0,41516). The aspects of Organizing Committee Satisfaction (M = 4,6933) and Presenter Satisfaction (M = 4,6267) received very positive ratings, primarily due to the clarity of the material presented by UM Educational Technology faculty members as well as the responsive and attentive technical assistance provided by undergraduate Educational Technology students during the in-person practical sessions. The involvement of students as facilitators proved to help directly address teachers' operational challenges, consistent with the reports by Amri & Wibowo (2025) and Agusta & Astriawati (2025) regarding the importance of intensive practical guidance in digital training for elementary school teachers.

Although teacher satisfaction levels were very high, the results of the Spearman correlation test showed no significant linear relationship between total satisfaction scores and cognitive gain scores (r_s = 0,157; p = 0,575). These empirical findings support the evaluation principles outlined by Kirkpatrick & Kirkpatrick (2016), which assert that participants' affective satisfaction with the training (Level 1) does not automatically correlate positively with cognitive learning outcomes (Level 2). Positive reactions reflect satisfaction with the instructors' friendliness, the readiness of the facilities, and a well-organized program flow; however, success in cognitive improvement is more determined by teachers' independent mental engagement while completing asynchronous tasks. This simultaneously corrects the assumption that training satisfaction is linearly proportional to a surge in participants' learning outcomes.

Dynamics of Individual Variation and Limitations of the Ceiling Effect

An analysis of individual cognitive score data identified the presence of a ceiling effect in the test instrument, in which 6 out of 16 teachers (37.5%) achieved a post-test score of 98 points. According to Hake (1998) and Shadish, Cook, & Campbell (2002), the clustering of scores at the upper limit indicates a restriction of the data range, which can bias the estimate of the effect size to be higher than it actually is. This condition

suggests that the test instrument was relatively easy for teachers who adapt quickly, and thus was not yet able to optimally distinguish levels of higher-order cognitive understanding.

In addition, there was significant variability in responses among participants. Participant 11 showed no increase in score at all (gain = 0; the pre-test and post-test scores remained at 34), whereas Participant 10 (N-gain = 0.217), Participant 13 (N-gain = 0.217), and Participant 16 (N-gain = 0.280) fell into the low-effectiveness category (N-gain < 0.30). This indicates that the training intervention did not necessarily have a uniform impact on all teachers. Differences in the pace of adaptation and basic ICT literacy among elementary school teachers call for more personalized guidance, as expressed in the teachers' open-ended responses, in which they hoped for an increase in the amount of hands-on practice and ongoing mentoring.

Methodological Reflections on the Pre-Experimental Design

The use of a one-group pretest-posttest design in this study has limitations in drawing purely causal conclusions, given the absence of a comparison control group, as noted by Shadish et al. (2002) and Creswell & Creswell (2023). There are several threats to internal validity that must be openly acknowledged.

First, the Testing Effect: The use of identical pre-test and post-test items means that some of the increase in cognitive scores may be influenced by the participants' familiarity with or recognition of the items.

Second, Instructor-Evaluator Bias: The team of community service volunteers, who acted as both instructors and data collectors, had the potential to introduce experimenter expectancies as well as a tendency for participants to provide survey responses that would please the committee (social desirability bias).

Third, the Hawthorne Effect: Teachers' motivation to learn during both in-person and asynchronous training may be driven by the awareness that they are the subjects of a university professional development program.

Furthermore, the evaluation of this program is currently limited to measuring short-term cognitive understanding (Kirkpatrick Level 2) and perceived reactions (Kirkpatrick Level 1), and has not yet measured teachers' actual implementation behaviors in the classroom (Level 3) or student learning outcomes (Level 4). Nevertheless, the empirical data obtained demonstrate that this AI-assisted structured training is beneficial in equipping elementary school teachers with the conceptual knowledge needed to prepare for future digital classroom environments.

Limitation and Future Work

Although this training intervention proved effective in improving the cognitive competencies of elementary school teachers, this study has a number of methodological, contextual, and psychometric limitations that affect the generalizability and interpretation of the findings. From a methodological perspective, the use of a one-group pretest-posttest pre-experimental design without a comparison control group creates vulnerability to threats to internal validity, such as the testing effect resulting from the use of identical test instruments before and after the training, potential instructor-evaluator bias (social desirability bias), and the Hawthorne effect due to participants' awareness that they were being observed by the university team. Furthermore, the small sample size—comprising only 16 teachers at two elementary schools in Ngajum Subdistrict, Malang Regency—and the absence of detailed demographic variables (such as age, years of service, and ICT experience) limit the generalizability of the findings to other school contexts, madrasahs, or urban areas. Psychometrically, the cognitive test instrument has not undergone formal construct validation and exhibits a ceiling effect, as 37.5% of teachers ($n = 6$) achieved a score of 98 on the post-test, which could potentially skew the estimate of the high effect size ($d_z = 1{,}22$ due to the compression of variance at the upper end of the score range. The evaluation of this program is also still limited to Level 1 (Reaction) and Level 2 (Learning) in the Kirkpatrick model, without measuring long-term knowledge retention, the transfer of teaching behaviors in real classrooms (Level 3), or its impact on the learning outcomes of elementary school students (Level 4). Therefore, future research is recommended to employ a quasi-experimental or pure experimental design with a control group, expand the sample size and stratification across educational units, calibrate test instruments using the Item Response Theory (IRT) approach to eliminate the ceiling effect, and conduct a multi-level longitudinal evaluation that includes authentic assessments of Moodle digital classroom products and their impact on student learning outcomes.

Implications

The empirical findings of this study offer substantial theoretical, practical, and policy implications for enhancing the quality of digital learning in elementary schools and madrasahs. Theoretically, the operationalization of the prompt engineering formula on Google Gemini enriches the AI-TPACK framework while validating Cognitive Load Theory, in which AI is shown to function as external cognitive scaffolding that reduces extraneous cognitive load in writing HTML syntax and inline CSS, allowing teachers to focus their mental capacity on pedagogical design and content substance. The finding that participant satisfaction does not correlate linearly and significantly with cognitive improvement ($r_s = 0{,}157; p = 0{,}575$) further reinforces the theoretical foundation of the Kirkpatrick training evaluation model, which holds that affective comfort with the instructor and facilities does not necessarily reflect deep conceptual mastery. In practical terms, this program equips

elementary school teachers with alternative, non-coding methods to transition from merely distributing static, one-way materials to managing an interactive, structured, child-friendly Moodle LMS environment integrated with an AIKEN-formatted question bank. The involvement of educational technology students as technical facilitators during the 32 IH training session also underscores the importance of intensive guidance (near-peer scaffolding) to reduce resistance to technology adoption among novice teachers. At the institutional policy level, these findings encourage school principals, supervisors, and education policymakers (the Education Office and the Ministry of Religious Affairs) not to prioritize solely the provision of hardware (such as interactive flat-panel displays and internet connections), but rather to allocate resources for sustainable, standalone Moodle server and facilitate sustainable, personalized mentoring-based training programs to address disparities in the pace of digital adaptation among teachers.

CONCLUSION

The AI-Assisted Moodle Content Organization Training proved effective in enhancing elementary school teachers' cognitive understanding (Kirkpatrick Level 2) while also receiving "Very Good" satisfaction ratings from participants (Kirkpatrick Level 1). In general, the use of generative artificial intelligence through structured instructional formulas functions effectively as a cognitive scaffold that reduces the technical complexity of web coding, enabling elementary school teachers with limited digital literacy to master the management of modules and the design of digital assessments in Moodle in a practical manner. On the other hand, the absence of a linear correlation between satisfaction and increases in cognitive scores confirms that affective satisfaction with the facilities and instructors plays a crucial role in creating a conducive learning environment, but is not the sole determinant of mastery of the material.

This study has methodological limitations that must be openly acknowledged, namely the use of a pre-experimental design without a comparison control group, a sample size limited to two partner schools, and the occurrence of a ceiling effect in the cognitive test instrument, which limits the differentiation of participants' higher-order competencies. Furthermore, the evaluation of the new program focuses on immediate reactions and short-term cognitive mastery without measuring knowledge retention over a longer period of time.

As a follow-up recommendation, schools and policymakers are advised to provide independent server infrastructure and regular guidance so that teachers can implement digital classrooms on a sustainable basis in real-world classrooms. For future researchers, it is recommended to use an experimental design with a comparison control group, adjust the difficulty level of the test instruments to avoid a ceiling effect, and expand the evaluation to include authentic assessment of digital classroom products, the transfer of teaching behaviors in the classroom (Kirkpatrick Level 3), and the impact on student learning outcomes (Kirkpatrick Level 4).

Acknowledgements

The author would like to express deep appreciation and gratitude to the principals, teaching staff, and educational support staff at SDN 1 Maguan and SDN 2 Maguan, Ngajum Subdistrict, Malang Regency, for their partnership and active participation throughout the 32 instructional hours of this AI-assisted Moodle content organization training, to the Department of Educational Technology, Faculty of Education, State University of Malang (UM), for its institutional support and academic guidance, and to CV KAL Project for providing a dedicated server infrastructure and technical maintenance of the Moodle LMS system throughout the program, as well as to the UM Educational Technology students who dedicated their time to assist as technical facilitators in supporting teachers during both in-person training sessions and asynchronous independent assignments.

Authors' contributions

All authors were involved in the preparation of the manuscript. The contributions of each author are described as follows.

CRediT role	Author							
	ANFG	ANS	ANA	GS	IDR	IAM	IMP	YP
Conceptualization	√							√
Methodology	√							√
Software	√	√				√		
Validation	√							√
Formal analysis	√							√
Investigation	√	√	√	√	√	√	√	
Resources			√		√			√
Data curation	√	√	√	√	√			
Writing – original draft	√							

CRediT role	Author							
	ANFG	ANS	ANA	GS	IDR	IAM	IMP	YP
Writing – review & editing	√	√	√	√	√	√	√	√
Visualization	√			√		√		
Supervision								√
Project administration							√	√
Funding acquisition	√							√

Funding Statement
This research and community service project was self-funded through the 2026 internal community service program allocation of Malang State University (UM BBM), with technical support for server infrastructure provided by CV KAL Project. The author declares that he did not receive any specific research grants from any external funding agencies in the public, commercial, or nonprofit sectors for the conduct of this research or the preparation of this manuscript.

Conflict of Interest
All authors declare that they have no financial, professional, personal, or institutional affiliations with any party (including the Google Gemini platform provider or the CV KAL Project server provider) that could potentially give rise to a conflict of interest or be deemed to influence the objectivity, data analysis, and conclusions drawn in this publication.

AI Declaration
The authors states that the artificial intelligence (AI) tool, Google Gemini, was used in the preparation of this manuscript solely to assist with academic language editing, translating the draft manuscript, and refining the writing structure. The use of AI does not replace the authors' scientific responsibility; all conceptual formulations, cognitive and satisfaction-related statistical analyses, thematic interpretations, verification of citations, and the integrity of the manuscript data have been fully reviewed, validated, and accounted for by the authors, without listing AI as part of the authorship.

Ethical Approval
The research procedures for this training activity complied with the principles of educational research ethics and were institutionally approved by the Department of Educational Technology, Faculty of Education, Malang State University, and received official permission from the school administrators at SDN 1 Maguan and SDN 2 Maguan, Malang Regency. All teachers participating in the study received an information sheet explaining the activities and signed a written informed consent form before the tests and questionnaires were administered, with a guarantee of anonymity and full confidentiality of personal data.

Data Availability Statement
The empirical data supporting the findings of this study—including tabulated data on pre-test and post-test cognitive scores, a summary of questionnaire data on participants' satisfaction, and anonymized transcripts of open-ended responses—are available and can be accessed upon submission of a written, well-reasoned request to the corresponding author (Yulias Prihatmoko, email: yulias.prihatmoko.fip@um.ac.id) for the purposes of scientific verification and academic replication, while respecting the confidentiality of participants.

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