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The Effect of Learning Management System with TRINGO Strategy on Technological Content Knowledge in Procedural Setting

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Abstract: The Effect of Learning Management System with TRINGO Strategy on Technological Content Knowledge in Procedural Setting. **Objectives:** This study aims to evaluate the effect of using the Learning Management System (LMS) combined with the TRINGO strategy on procedural learning outcomes (nglakoni) of educators who are also Muhammadiyah cadres in Malang City. TRINGO strategy, which consists of three stages, namely conceptual understanding (ngerti), emotional experience (ngrasa), and practical application (nglakoni) integrated in the use of LMS to improve the quality of education. **Methods:** This study used a quantitative approach with a one group pretest-posttest only quasi-experiment design. A total of 45 educators from 21 Muhammadiyah schools became respondents in this study. Data analysis was conducted using SPSS 27 through Wilcoxon test and multiple linear regression to test the proposed hypothesis. **Findings:** The results showed that the use of LMS in TRINGO strategy significantly improved the concept understanding (ngerti) and emotional engagement (ngrasa) of the educators, with Z values of -5.982 and -6.214, respectively, and a significance value of 0.000. Furthermore, the combination of the LMS with the TRINGO strategy simultaneously had a significant effect on procedural learning outcomes (nglakoni), as indicated by an F-count of 94.550 (greater than the F-table of 3.21) and a coefficient of determination (R Square) of 0.818, indicating that 81.8% of the variation in procedural learning outcomes can be explained in this research. **Conclusion:** The conclusion of this study confirms that the integration of LMS with TRINGO strategy is effective in improving the procedural learning outcomes of cadres & educators, and provides important implications for the development of technology-based learning methods in Muhammadiyah educational environment. The results of this study are expected to contribute to the development of more effective learning models, especially in the context of cadre-based education in Indonesia.

Keywords: LMS, TPaCK, tringo strategy, educational technology, muhammadiyah.

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INTRODUCTION

The global education paradigm has undergone a shift from traditional approaches based on face-to-face methods and one-way teaching towards more technology-based and adaptive models (Reigeluth et al., 2016). This shift is influenced by advances in information and communication technology (ICT) that have

enabled innovations in the way learning materials are delivered and received (Alassaf et al., 2014; Golshani et al., 2011; Mershad & Wakim, 2018). In this context, Learning Management System (LMS) emerges as a solution that facilitates the management of education in a more efficient and structured way (Reigeluth et al., 2008). An LMS offers a digital platform that supports various educational functions, including material delivery, assessment, and interaction between educators and learners (Rahman et al., 2010; Zainul et al., 2020).

The modern educational paradigm promotes a constructivist approach that emphasizes active and collaborative learning, as well as student involvement in the learning process (Alserhan & Yahaya, 2021; Conde et al., 2014; Gautreau, 2011). These changes lead to more flexible learning models that are based on individual needs and context (Wandani et al., 2023). Digital technologies, including LMSs, play an important role in supporting this paradigm shift by providing tools that enable more interactive and adaptive teaching (Turnbull et al., 2021).

LMS is a technology-based platform that allows educators to manage and deliver learning materials in an integrated manner (Pratama & Wahyu, 2021; Wiragunawan, 2022). Features such as discussion forums, online quizzes, and assignment management systems, provided by an LMS, make it easier to manage and access learning materials for students (Akhmedova & Rahmatova, 2024). Research shows that the use of LMS can improve student engagement and learning outcomes by providing flexibility in terms of time and place of access to materials (Duta et al., 2021; Firat, 2016; Simanullang & Rajagukguk, 2020).

LMS supports the learning process by providing quick and integrated feedback, which is a key element in effective learning (Alomari et al., 2020). With an LMS, educators can manage materials, assignments and evaluations efficiently, and provide more personalized support to students through interactive features (PARK et al., 2024; Sriyanti & Jauhari, 2014). Additionally, the system facilitates continuous communication between students and educators, enhancing collaboration and fostering a more engaging learning environment.

The TRINGO strategy, which stands for "Ngerti, Ngrasa, Nglakoni," is a pedagogical approach that focuses on three main stages: understanding (ngerti), emotional experience (ngrasa), and practical application (nglakoni) (Indarti, 2018; Kuswandi et al., 2021). This strategy is designed to improve learning outcomes by providing a thorough and integrated learning experience (Az-Zahroh et al., 2019; Kuswandi et al., 2021).

The first stage, "Ngerti," emphasizes understanding basic concepts and information. In the context of the LMS, this stage involves delivering material through modules that are presented clearly and systematically. The second stage, "Ngrasa," focuses on the emotional experience and motivation of students. The LMS can support this stage by providing interactive features that increase student engagement, such as discussion forums and collaborative activities (Dermawan et al., 2024; Fikri et al., 2023). The final stage, "Nglakoni," is the practical application of the learned knowledge. The LMS allows educators to provide practical tasks and relevant evaluations, so that students can apply and test their understanding in a real context (Kuswandi, 2023).

The application of LMS with the TRINGO strategy has great potential in improving the quality of education in the Muhammadiyah environment. Muhammadiyah, as a large Islamic organization with many educational institutions from primary to secondary school levels, can utilize educational technology to improve the competence of its

cadres (Ahmad, 2015). Digital education integrated with LMS can help educators, who are also Muhammadiyah cadres, improve their teaching quality and learning outcomes (Nadirah & Khalid, 2016).

Muhammadiyah Institution, as one of the largest Islamic organizations in Indonesia with an extensive educational network, has great potential to utilize digital technology in improving the competence of its cadres (Al Faruq, 2020). The integration of the LMS and the TRINGO strategy is expected to have a positive impact on improving the pedagogical abilities and procedural learning outcomes of educators (Thaariq et al., 2024), which in turn can improve the quality of education in Muhammadiyah schools.

This study used a quantitative approach with a quasi-experimental design, through one group pretest-posttest only, to evaluate the effect of using the LMS combined with the TRINGO strategy on the procedural learning outcomes of educators. The research sample consisted of 45 teachers as well as Muhammadiyah cadres from 21 Muhammadiyah schools in Malang City. The analysis was conducted using the Wilcoxon test as a non-parametric statistic to test for significant differences between pretest and posttest scores (Rudianto et al., 2020). In addition, multiple linear regression analysis was used to identify the relationship between the independent variable (use of LMS with TRINGO strategy) and the dependent variable (procedural learning outcomes) (Janie, 2012). This method is expected to provide a clear picture of how much influence the integration of LMS and TRINGO strategy has on procedural learning outcomes, as well as the factors that influence the effectiveness of its application in the context of Muhammadiyah education.

However, researching this requires the participation of educational technologists as learning facilitators and instructors (Wetzel et al., 2014). As the role of educational technology, according to the Association for Educational Communications and Technology (AECT), educational technology has an important role in improving performance and facilitating learning (Hastings & Bauman, 2020). Educational technology serves as a tool that supports the teaching and learning process in a more effective and efficient way (AECT, 2018). In this context, an LMS implemented with TRINGO strategy can improve learning performance by providing a platform that supports interaction, collaboration and practical application of knowledge.

The urgency of LMS development in the realm of Muhammadiyah education is also very significant. Based on empirical studies conducted through literature searches and interviews, there is no adequate and valid digital literature platform for Muhammadiyah in Malang City. This shows that there is an urgent need to create a platform that can accommodate and distribute digital learning content effectively. Therefore, the author raises this research topic with the hope that increasing the competence of human resources of teachers who are also Muhammadiyah cadres in Malang City in developing digital learning content can accelerate the development of the platform. In the context of facilitating learning, the authors prepare an LMS that will later be filled by Muhammadiyah teachers and cadres according to their scientific disciplines and also other teaching media (Sinaga et al., 2024). Meanwhile, in improving performance, training using the TRINGO approach aims to improve the TCK competence of Muhammadiyah cadres so that the product is sustainable.

This study focuses on the effect of the combination of LMS with TRINGO strategy on the procedural learning outcomes of educators who are also Muhammadiyah cadres in Malang City. The respondents consisted of 45 educators from 21 Muhammadiyah schools. As teachers as

well as Muhammadiyah cadres, they are expected to utilize the LMS with the TRINGO strategy to significantly improve their competence and learning outcomes.

Based on the background that has been explained, this research is focused on the following three research questions: **RQ1)** Does the use of LMS significantly improve concept understanding (ngerti) in TRINGO strategy?; **RQ2)** Does the use of LMS in TRINGO strategy affect the emotional engagement (ngrasa) of educators?; **RQ3)** Does the combination of LMS with TRINGO strategy significantly affect the procedural learning outcomes (nglakoni) of educators? To answer these questions, this study will test three hypotheses as follows:

H1. The use of LMS significantly improves concept understanding (ngerti) in TRINGO strategy.
H2. The use of LMS in the TRINGO strategy has a significant influence on the emotional involvement (ngrasa) of educators.
H3. The combination of LMS with TRINGO strategy significantly affects the procedural learning outcomes (nglakoni) of educators.

The results of this study are expected to contribute significantly to the development of technology-based learning models that can be applied in various educational institutions, especially in the context of religious organizations and cadre-based education.

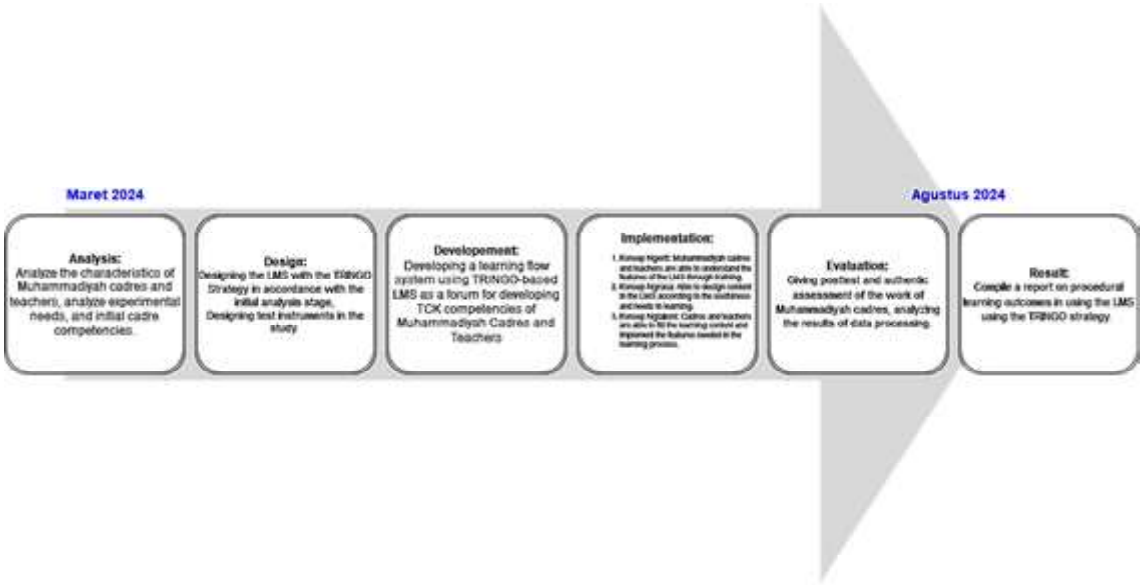
METHOD

Research Design

This study used a quantitative approach with a quasi-experimental research design with a one group pretest-posttest only model. This design involves measuring one group of subjects before and after an intervention without a control group. This design is suitable for evaluating changes that occur due to intervention (in this case, the use of LMS with TRINGO strategy). Then testing was done with Wilcoxon test to answer RQ1 & RQ2. Then multiple linear regression analysis to evaluate and answer RQ3, namely the effect of LMS combined with TRINGO strategy on procedural learning outcomes. Linear regression was chosen for its ability to identify the relationship between the independent variable (LMS and TRINGO strategy) and the dependent variable (procedural learning outcomes) and measure the strength and direction of the relationship (Janie, 2012; Sugiyono, 2022).

The sampling technique used in this study was purposive sampling. This technique was chosen because this research requires respondents who have special characteristics (Creswell & Creswell, 2017; Sugiyono, 2019), namely educators who are also Muhammadiyah cadres. A total of 45 respondents from 21 Muhammadiyah schools in Malang City were selected as research samples. Data collection was conducted through research instruments consisting of questionnaires and procedural learning outcomes tests. The questionnaire was designed to measure the extent to which the LMS and TRINGO strategy were applied in the learning process, while the procedural learning outcomes test was used to measure the improvement of educators' competencies and learning outcomes.

Linear regression analysis was conducted to test the hypothesis that the use of LMS combined with TRINGO strategy has a significant influence on procedural learning outcomes. This analysis will provide a clear picture of how much each independent variable contributes to the dependent variable, as well as provide useful information for the improvement and development of technology-based learning models in the future. The research procedure that the author did can be seen in the following figure:



The flow is adapted from the addie learning model procedure (Branch, 2009)

This research begins by analyzing the characteristics of Muhammadiyah cadres and teachers to understand their initial needs and competencies before being involved in the learning process using the Learning Management System (LMS) based on the TRINGO strategy. Initial data is gathered through a pretest administered via the Quizziz application to assess the participants' baseline level of Technological Content Knowledge (TCK).

Following the analysis stage, the research proceeds to the design phase, where the LMS is developed in accordance with the findings from the initial needs assessment. The LMS is integrated with the TRINGO strategy, aimed at enhancing participants' ability to understand and engage with technology-related content that aligns with their competencies. At this stage, the design of evaluation instruments is also carried out to ensure that the learning process aligns with the predetermined objectives.

Next, the designed LMS is implemented in the learning activities. During this phase, participants are trained to comprehend the features of the LMS, manage learning content, and use the LMS effectively in accordance with the learning needs identified during the analysis. This is followed by a posttest to measure the improvement in participants' competencies after utilizing the LMS.

Subsequently, an evaluation is conducted based on the posttest results and data analysis. This stage assesses the effectiveness of the LMS in improving participants' TCK competencies.

Finally, the research report is compiled, drawing conclusions based on the analysis of the pretest and posttest data, as well as the outcomes of the LMS implementation using the TRINGO strategy. The report highlights the impact of the learning process on enhancing the TCK competencies of Muhammadiyah cadres and teachers.

Participants

The population in this study consisted of Muhammadiyah educators and cadres in Malang City. The sample was selected using the purposive sampling technique. This technique was chosen because participants needed to meet specific criteria, namely being Muhammadiyah cadres or

educators. The purposive sampling method ensures that the selected participants are relevant to the study, as they are expected to possess the necessary qualifications in terms of competence and understanding of the educational framework within Muhammadiyah institutions. The sample was drawn from several Muhammadiyah schools, which were selected based on the results of a needs and competency analysis. This analysis ensured that the participants involved in the study were representative of various educational levels in Muhammadiyah schools in Malang City. As a result, a total of 45 Muhammadiyah cadres and teachers were selected from 21 Muhammadiyah schools in Malang City. The following table shows the number of participants from each institution:

Table 1. Respondent data muhammadiyah cadres and teachers in malang city

No	Name of Institution	Number of Participants	No	Name of Institution	Number of Participants
1	Madrasah Aliyah Muhammadiyah 1	**3**	**12**	MI Manarul Islam	**2**
2	Madrasah Aliyah Muhammadiyah 2	**2**	**13**	SD Aisyiyah	**2**
3	SMA Muhammadiyah 1	**2**	**14**	SD Muhammadiyah 1	**2**
4	SMK Muhammadiyah 1	**2**	**15**	SD Muhammadiyah 2	**2**
5	SMK Muhammadiyah 2	**2**	**16**	SMA Muhammadiyah 3	**2**
6	MTS Muhammadiyah 1	**2**	**17**	SMP Muhammadiyah 4	**2**
7	MTS Muhammadiyah 2	**2**	**18**	SMP Muhammadiyah 5	**2**
8	SMP Muhammadiyah 1	**2**	**19**	SMP Muhammadiyah 6	**2**
9	SMP Muhammadiyah 3	**2**	**20**	SMP Muhammadiyah 8	**4**
10	SMP Muhammadiyah 4	**2**	**21**	SMP Muhammadiyah 9	**2**
11	SMP Muhammadiyah 6	**2**			
Total	**Total Participants**				**45**

With this division, it is hoped that the participants involved can represent various levels of education und Muhammadiyah in Malang City.

Research Instruments

The primary data collection sources were a questionnaire and a procedural knowledge test consisting of 10 multiple-choice questions, administered through the Quizziz platform. The questionnaire provides a range of questions on the functions of features within the LMS and how to develop content, including concept understanding, emotional engagement, and practical application in accordance with the TRINGO strategy to enhance the Technological Content Knowledge (TCK) competencies of Muhammadiyah cadres. Meanwhile, the procedural knowledge test, which was administered as both a pre-test and a post-test, was designed to measure the learners' level of understanding and ability to apply the concepts that had been taught. The tests were conducted simultaneously by all participants using the Quizziz application to assess procedural learning outcomes. The following aspects can be described from the question indicators:

Instrument Validity and Reliability Testing

The number of items is 10 items by being tested first on 10 respondents from SMK Muhammadiyah 1 Malang City. Testing the validity of the instrument is done by measuring the correlation between the items on the questionnaire and the procedural knowledge test

Table 2. Procedural test instrument indicators

No	Question	Measured Aspect	Question Purpose Description
1	"What is the first step to create a new course in Moodle?"	Understanding (Ngerti)	Measures participants' understanding of the basic steps to initiate a new course, assessing conceptual knowledge.
2	"How do you add a new resource to a Moodle course?"	Applying (Nglakoni)	Measures participants' practical skills in adding new resources, assessing the ability to apply skills in using the platform.
3	"Which feature in Moodle allows instructors to assign tasks to students?"	Understanding (Ngerti)	Tests participants' knowledge in selecting the correct feature for assignments, measuring comprehension of basic instructions.
4	"In which feature is this activity located?"	Feeling (Ngrasa)	Assesses participants' perception of the features in Moodle and how they relate to activities, reflecting the emotional aspect in learning.
5	"What is the function of the 'Enrol' feature in Moodle?"	Understanding (Ngerti)	Measures participants' understanding of the basic function of the enrollment feature, reflecting users' knowledge level.
6	"How do you create student attendance in Moodle?"	Applying (Nglakoni)	Measures participants' skills in applying the attendance feature in Moodle, demonstrating the ability to perform practical actions.
7	"What is the first step to add an activity or resource in Moodle?"	Understanding (Ngerti)	This question evaluates understanding of the initial process for adding resources in Moodle, assessing mastery of basic steps.
8	"Which feature should be used to create assignments in Moodle?"	Feeling (Ngrasa)	Tests participants' ability to choose the correct feature for creating assignments, measuring understanding of task instruments.
9	"What is the benefit of the 'Forum' feature in Moodle?"	Feeling (Ngrasa)	Measures participants' perception and evaluation of the benefits of the forum feature, assessing attitudes and emotions toward its use in enhancing interaction.
10	"How do you create a new course in Moodle?"	Applying (Nglakoni)	Tests participants' practical skills in creating a new course, assessing the ability to implement learning strategies on the Moodle platform.

using the Pearson correlation test. The instrument used is considered valid if r count > 0.632.

Instrument reliability was tested using Cronbach's Alpha. The instrument is considered reliable if the Cronbach's Alpha value is > 0.70. Based on the validity test results, of the 10 question items the procedural knowledge pretest and posttest, all items were declared "valid".

The results of the validity test using Pearson Correlation and the significance value (Sig. 2-tailed), all items are declared valid. The correlation value of each item is greater than the r-table (0.632) and the significance value of each item is below 0.05. Therefore, all items meet the validity criteria and are suitable for use in this study. In the Pearson correlation analysis, it was found that there are significant positive correlations among several variables. The Pearson correlation values range from 0.639 to 0.909. Specifically, the stronger and more significant correlations were observed at 0.812 and 0.909, with significance levels below 0.01, indicating a highly significant relationship. Additionally, other correlation values ranging from 0.639 to 0.795 also showed significant positive correlations with varying significance levels between 0.014 and 0.047. This suggests a reasonably strong relationship among the variables analyzed in this study.

The reliability test results show that the Cronbach's Alpha value is 0.907 for the 10 items tested. Based on the criteria that the Cronbach's Alpha value> 0.7 indicates good reliability, it can

be concluded that the instrument used in this study is very reliable. The value of 0.907 indicates that the internal consistency between items is very high, so this instrument can be trusted to accurately measure the variables studied.

Data Collection

Data were collected in two stages: before (pretest) and after (posttest) the implementation of LMS with TRINGO strategy. At the pretest stage, respondents were given a procedural knowledge test through Quizziz and a questionnaire to measure their initial understanding of the material to be taught. After the implementation of the LMS and TRINGO strategy for one month, respondents were again given a posttest with the same questions to measure the improvement of their procedural knowledge.

Data Analysis

The data obtained from the pretest and posttest were processed by first tabulating per variable category. Frequency distribution was then calculated for each variable in order to obtain an initial picture of the data distribution. Furthermore, data analysis was carried out using SPSS version 27 software to test the research hypotheses.

First, to test the first hypothesis (H1) and the second hypothesis (H2), the Wilcoxon Signed-Rank Test was used. This test aims to determine whether there is a significant difference between the pretest and posttest scores on the variables of concept understanding (ngerti) and emotional involvement (ngrasa). The Wilcoxon test was chosen because it is suitable for measuring changes that occur in the same group of subjects after being given an intervention, especially when the data is not normally distributed or the number of participants is relatively small (Rakhmawati, 2019). The results of this analysis will show whether the use of the Learning Management System (LMS) combined with the TRINGO strategy significantly improves educators' concept understanding and emotional engagement.

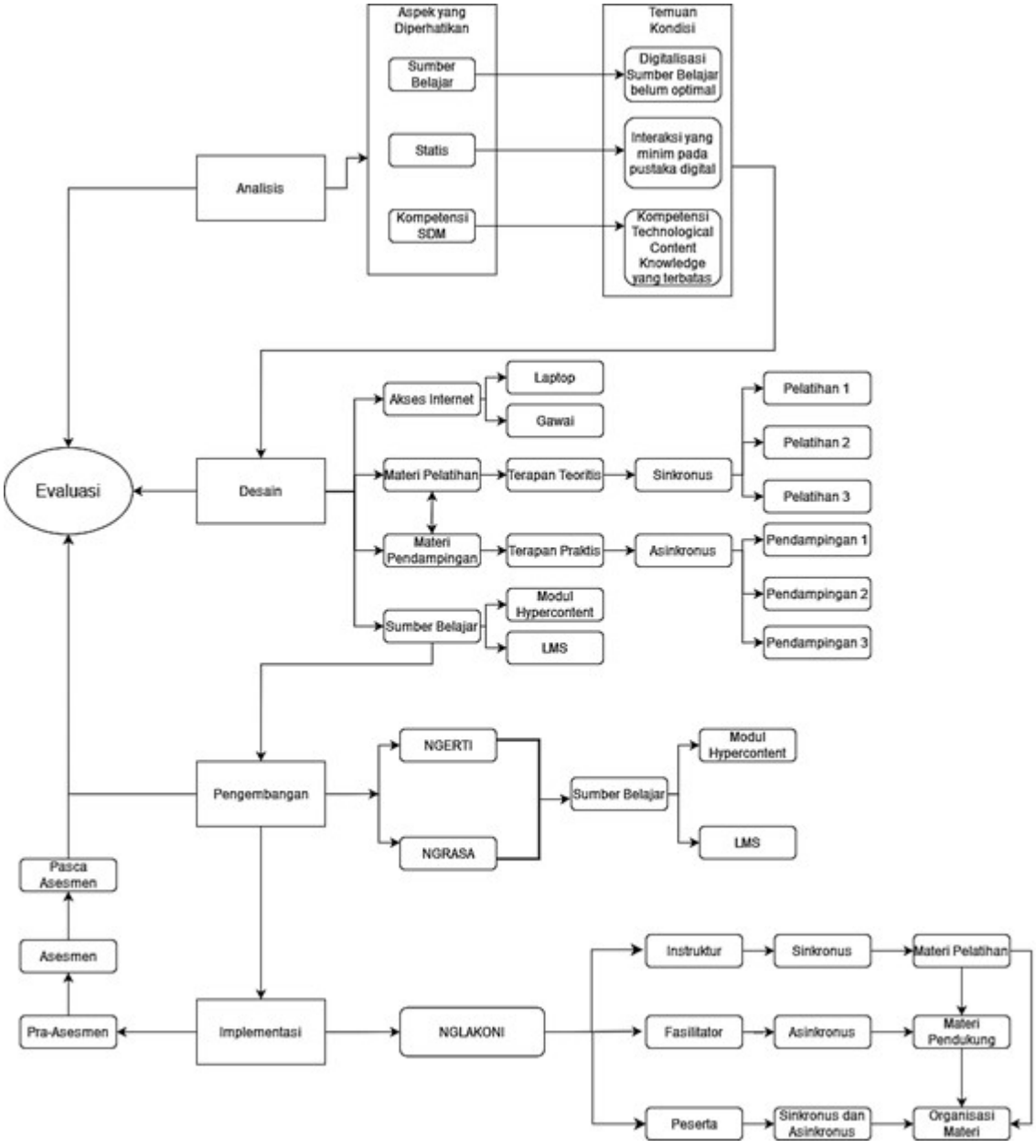
Furthermore, to test the third hypothesis (H3), Multiple Regression Analysis was conducted. This analysis was used to evaluate the simultaneous effect of the variables of concept understanding (ngerti) and emotional engagement (ngrasa) on the variable of procedural learning outcomes (nglakoni). In this analysis, concept understanding and emotional engagement were identified as independent variables, while procedural learning outcomes became the dependent variable.

Before carrying out the multiple regression analysis, several prerequisite tests were conducted to ensure the validity of the model used. Normality test was conducted using Kolmogorov-Smirnov to ensure that the data was normally distributed. A multicollinearity test was conducted using the Variance Inflation Factor (VIF) to detect potential multicollinearity issues, which indicates that there is no significant multicollinearity when the VIF is below 10. A linearity test was conducted using ANOVA, where a linear relationship between the independent and dependent variables should be proven significant ($F > 0.05$). Lastly, a homoscedasticity test is performed using the Glejser Test to ensure that the residual variance is constant, which is an important prerequisite in regression analysis.

The results of these tests showed that the data met all the necessary prerequisites: the data were normally distributed, there was no multicollinearity problem ($VIF < 10$), the linear relationship between variables proved significant ($F > 0.05$), and there was no homoskedasticity problem (Glejser Test was not significant). The multiple regression analysis conducted then revealed that the combined use of the LMS with the TRINGO strategy had a significant effect on improving the educators' procedural learning outcomes ($p < 0.05$).

Training Program Development

Based on the results of the needs analysis and initial competencies, an LMS training program based on the TRINGO strategy was developed. The program was designed to cover the three main principles of TRINGO: Ngerti (understanding), Ngrasa (feeling), and Nglakoni (doing). The training program includes learning modules that focus on the introduction of educational technology and TCK, understanding the role of technology in facilitating learning and improving performance, case studies and practical experiences in using technology in the classroom, reflection and discussion on the benefits and challenges of technology integration in learning, as well as hands-on practice in developing digital content and managing LMS. Mentoring and evaluation in the implementation of learning technology are also included to ensure effective application of the training materials.



Learning Flowchart Adapted from Thaariq et al (2024)

Measurement of Training Effectiveness

Training effectiveness is measured using a pre-test and post-test design. Participants will fill out the TCK competency questionnaire before and after attending the training. The pre-test and post-test results will be compared to measure the improvement of participants' TCK competence.

This research methodology is designed to provide a comprehensive picture of the needs and initial TCK competencies of Muhammadiyah teachers and cadres, as well as develop and measure the effectiveness of the LMS training program based on the TRINGO strategy. It is expected that this research can make a significant contribution in improving TCK competencies and supporting the development of digital education in the Muhammadiyah environment.

■ RESULT AND DISCUSSION

H1: Does the use of LMS significantly improve concept understanding (ngerti) in TRINGO strategy?

To answer this question, the Wilcoxon Signed-Rank Test was conducted to compare the average pretest and posttest scores in concept understanding (ngerti) after the use of the LMS. The results revealed that none of the participants experienced a decrease in scores from the pretest to the posttest, as indicated by the absence of any negative ranks. In contrast, all 45 participants showed an improvement in their posttest scores compared to their pretest scores. This is reflected in the fact that there were 45 positive ranks, with a mean rank of 23.00 and a sum of ranks of 1035.00. These results indicate a significant increase in the participants' understanding of the concepts after using the LMS.

Furthermore, the results from the "Test Statistics" indicate that the Z value obtained is -5.982 with an Asymptotic Significance (2-tailed) of 0.000. Based on the decision-making criteria for the Wilcoxon test, if the Asymptotic Significance is less than 0.05 (Asymp. Sig. <0.05), the null hypothesis (which states that there is no difference between pretest and posttest scores) is rejected. This means that the alternative hypothesis, which asserts that there is a significant difference between the pretest and posttest scores, is accepted.

Based on the data analysis, it was found that the use of Learning Management System (LMS) in the application of TRINGO strategy significantly improved the concept understanding (ngerti) of the educators. This result supports the first hypothesis (H1), which states that the LMS makes a positive contribution to improving concept understanding in the learning context. The concept understanding indicator was measured through the increase in pre-test and post-test scores which showed a significant increase after the application of the LMS.

Thus, these results indicate that the use of the LMS significantly improved the understanding of procedural concepts (ngerti) in the TRINGO strategy. The improvement observed across participants suggests that the integration of this method is effective in the educational context in which it was implemented, particularly in the Muhammadiyah schools involved in this study. In addition, interviews with educators also revealed that the interactive features of the LMS helped in clarifying the concepts taught, which in turn improved the understanding of procedural concepts.

H2: How does the use of LMS in TRINGO strategy affect the emotional engagement (ngrasa) of educators?

In this study, Research Question 2 (RQ2) aims to answer the question, "How does the use of the Learning Management System (LMS) in the TRINGO strategy affect the emotional engagement (ngrasa) of educators?" The second hypothesis (H2) tested states that the use of LMS in the TRINGO strategy has a significant influence on emotional engagement (ngrasa) of educators,

Based on the results of the Wilcoxon Signed-Rank Test, there were no negative ranks observed, meaning that none of the 45 participants experienced a decrease in their emotional engagement scores from the pretest to the posttest. On the contrary, all participants showed a significant increase in emotional engagement, as indicated by the 45 positive ranks, with a mean rank of 23.00 and a sum of ranks of 1035.00. This result suggests that the use of the LMS in the TRINGO strategy had a positive and significant effect on the emotional engagement of the educators involved in the study..

In the "Test Statistics," the Z value obtained was -6.214, with an Asymp. Sig. (2-tailed) of <0.001. According to the decision-making criteria for the Wilcoxon test, when the Asymp. Sig. < 0.05, the null hypothesis (H0) is rejected. This means that the alternative hypothesis (H2), which states that there is a significant difference in the emotional engagement (ngrasa) of educators before and after the intervention, is accepted.

Thus, the results of the analysis indicate that the use of the LMS in the TRINGO strategy significantly increased educators' emotional engagement (ngrasa). The observed improvement across participants provides empirical evidence that the integration of the LMS and TRINGO strategy is effective in increasing emotional engagement, which is an important aspect in the learning process. This conclusion supports the assertion that innovative and technology-based learning strategies can have a positive impact on the emotional dimension of educators in Muhammadiyah education environment.

H3: Does the combination of LMS with TRINGO strategy significantly affect the procedural learning outcomes (nglakoni) of educators?

To answer RQ3, multiple regression analysis was used to see the effect of the independent variables, namely concept understanding (X1) and emotional engagement (X2), on procedural learning outcomes (Y). This RQ3 can be explained as follows:

H1: There is an effect of Concept Understanding (Ngerti) (X1) on Procedural Learning Outcomes (Y)

H2: There is an effect of Emotional Engagement (Ngrasa) (X2) on Procedural Learning Outcomes (Y)

H3: There is an effect of Concept Understanding (Ngerti) (X1) and Emotional Involvement (Ngrasa) (X2) simultaneously on procedural learning outcomes (nglakoni). The results of the analysis can be seen in the following table:

Table 3. H1 and H2 test results on H3

Coefficients[a]						
	Model	**Unstandardized Coefficients**		**Standardized Coefficients**	**t**	**Sig.**
		B	**Std. Error**	**Beta**		
1	(Constant)	31.963	3.848		8.307	.000
	Pemahaman Konsep (X1)	.231	.127	.321	1.814	.077
	Keterlibatan Emosional (X2)	.483	.143	.599	3.387	.002

a. Dependent Variable: Hasil Belajar Prosedural (Y)

Analysis of Hypothesis:

Testing the First Hypothesis (H1): Effect of Concept Understanding (X1) on Procedural Learning Outcomes (Y)

From the results of multiple regression analysis displayed in the coefficient table, the t-count value for the Concept Understanding variable (X1) is 1.814. When compared with the t-table of 2.01808 (with á = 0.05 and degrees of freedom (df) = n-k-1 = 45-2-1 = 42), this t-count value is smaller than the t-table (1.814 < 2.01808). In addition, the significance value (Sig.) obtained is 0.077, which is greater than 0.05 (0.077 > 0.05).

Interpretation: Based on the decision-making law, since the t-count < t-table and the value of Sig. > 0.05, the first hypothesis (H1) which states that "Concept Understanding (X1) has a significant influence on Procedural Learning Outcomes (Y)" is rejected. This means, statistically, there is no significant influence between concept understanding and procedural learning outcomes in the context of this study.

Second Hypothesis Testing (H2): The Effect of Emotional Involvement (X2) on Procedural Learning Outcomes (Y)

For the Emotional Involvement (X2) variable, the t-count value obtained is 3.387. This value is greater than the t-table of 2.01808 (3.387 > 2.01808). The resulting significance value (Sig.) is 0.002, which is much smaller than 0.05 (0.002 < 0.05).

Interpretation: Thus, since the t-count > t-table and the value of Sig. < 0.05, the second hypothesis (H2) which states that "Emotional Involvement (X2) has a significant influence on Procedural Learning Outcomes (Y)" is accepted. This indicates that emotional engagement has a significant influence on improving the procedural learning outcomes of the educators in this study.

Third Hypothesis Testing (H3): The Effect of Concept Understanding (X1) and Emotional (X2) Engagement simultaneously on Procedural Learning Outcomes (Nglakoni) (Y).

Table 4. H3 test result of RQ3

ANOVA[a]						
Model		**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	Regression	9375.441	2	4687.720	94.550	.000[b]
	Residual	2082.337	42	49.579		
	Total	11457.778	44			

Based on the results of multiple regression tests conducted to test the third hypothesis (H3), it is known that Emotional Involvement (X2) and Concept Understanding (X1) simultaneously have a significant influence on Procedural Learning Outcomes (Nglakoni) (Y). The analysis results displayed in the ANOVA table show that the F-count value obtained is 94.550, which is much greater than the F-table of 3.21. In addition, the significance value (Sig.) obtained is <0.001, which is smaller than 0.05. Based on the basis of decision-making in regression, since F-count > F-table and Sig. < 0.05, it can be concluded that the third hypothesis (H3) is accepted.

This means that simultaneously, Concept Understanding (X1) and Emotional Engagement (X2) make a significant contribution to the improvement of Procedural Learning Outcomes (Y) of educators. In other words, the two independent variables, when combined, have a noticeable impact in influencing procedural learning outcomes. This finding confirms the

importance of the integration between deep understanding of the teaching material and positive emotional engagement in the learning process.

Based on the results of multiple regression tests conducted, the third hypothesis (H3) which states that Emotional Involvement (X2) and Concept Understanding (X1) simultaneously have a significant influence on Procedural Learning Outcomes (Nglakoni) (Y), is proven correct. From the ANOVA table, the F-count value of 94.550 is much greater than the F-table of 3.21, with a very small significance value (Sig.) of <0.001. This indicates that statistically, the combination of the two independent variables significantly influenced the educators' procedural learning outcomes.

Table 5. Coefficient of determination

Model Summary				
Model	**R**	**R Square**	**Adjusted R Square**	**Std. Error of the Estimate**
1	.905[a]	.818	.810	7.04127

Based on the output displayed in the model summary table, it is known that the R Square value is 0.818. This implies that the effect of the Emotional Involvement (X2) and Concept Understanding (X1) variables simultaneously on the Procedural Learning Outcomes (Y) variable is 81.8%. This means that the regression model used in this study is able to explain 81.8% of the variation that occurs in the procedural learning outcomes of educators, while the remaining 18.2% is influenced by other factors that are not included in this research model.

Testing the third hypothesis (H3) showed that the combination of LMS with TRINGO strategy significantly affected the procedural learning outcomes (nglakoni) of the educators. Procedural learning outcomes were measured through educators' ability to apply the TRINGO strategy in real learning situations after the training. The data showed a significant increase in educators' ability to put the knowledge they gained into practice, indicating the effectiveness of combining the LMS with the TRINGO strategy. Observations during the training and assessment of assigned tasks also showed that educators were able to implement learning procedures more effectively after using the LMS.

This result thus directly answers Research Question 3 (RQ3): "Does the combination of LMS with TRINGO strategy significantly affect the procedural learning outcomes (nglakoni) of the educators?" The answer is yes, the combination of LMS with TRINGO strategy has a significant influence on the procedural learning outcomes of the educators. This result confirms that improved learning outcomes do not depend on one aspect of learning alone, but are the result of an effective integration of learning technology (LMS) and learning strategies that promote concept understanding and emotional engagement. This study provides empirical evidence that a holistic approach that integrates cognitive and affective aspects is key in improving Technological Content Knowledge (TCK) procedural learning outcomes among Muhammadiyah educators.

■ CONCLUSION

The conclusion of this study shows that the combined use of Learning Management System (LMS) with TRINGO strategy significantly affects the procedural learning outcomes (nglakoni) of the educators. From the multiple regression test results, it was found that emotional

engagement (X2) had a significant influence on procedural learning outcomes, while concept understanding (X1) individually showed no significant influence. However, when these two variables were tested simultaneously, they both contributed significantly to the improvement of procedural learning outcomes. This is reinforced by the coefficient of determination (R Square) value of 0.818, which indicates that 81.8% of the variation in procedural learning outcomes can be explained by educators' emotional engagement and concept understanding.

Thus, this study confirms that the application of the LMS combined with the TRINGO strategy is effective in improving procedural learning outcomes, especially when aspects of emotional engagement and concept understanding are well managed. This conclusion provides important implications for educational development, particularly in Muhammadiyah schools, where the integration of technology and appropriate pedagogical strategies can have a significant positive impact on the quality of learning.

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