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THE EFFECT OF KAHOOT-ASSISTED MISSOURI MATHEMATICS PROJECT LEARNING MODEL ON STUDENTS' MATHEMATICAL CONCEPT UNDERSTANDING ABILITY

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ABSTRAK
This study aims to determine whether the Missouri Mathematics Project (MMP) learning model, assisted by Kahoot, influences students' mathematical conceptual understanding regarding the topic of Systems of Linear Equations in Three Variables (SPLTV). This quantitative study employed a quasi-experimental method with a pretest-posttest control group design. The participants were 68 tenth-grade students at SMA Negeri 1 Selesai, divided into an experimental group and a control group, with 34 students in each group. The data were analyzed using One-Way Analysis of Covariance (ANCOVA), considering students' initial abilities, and N-Gain to measure learning improvement. The results showed that the experimental group achieved a higher mean posttest score (80.94) than the control group (73.41). ANCOVA results indicated a significance value of 0.000 < 0.05, with a Partial Eta Squared of 0.308. The N-Gain scores were 0.597 for the experimental group and 0.412 for the control group. Thus, MMP assisted by Kahoot had a positive and significant effect on students' mathematical conceptual understanding.
Kata kunci: Kahoot; mathematical concept understanding; missouri mathematics projec: three-variable linear equation system.

ABSTRACT
Penelitian ini bertujuan untuk mengetahui ada tidaknya pengaruh model pembelajaran Missouri Mathematics Project (MMP) berbantuan Kahoot terhadap kemampuan pemahaman konsep matematis siswa pada materi Sistem Persamaan Linear Tiga Variabel (SPLTV). Penelitian ini menggunakan pendekatan kuantitatif dengan metode kuasi-eksperimen dan desain pretest-posttest control group. Subjek penelitian berjumlah 68 siswa kelas X SMA Negeri 1 Selesai yang terbagi dalam kelompok eksperimen dan kelompok kontrol, masing-masing 34 siswa. Data dianalisis menggunakan One-Way ANCOVA dengan mempertimbangkan kemampuan awal siswa serta N-Gain untuk mengukur peningkatan kemampuan. Hasil penelitian menunjukkan rata-rata posttest kelompok eksperimen sebesar 80,94, lebih tinggi dibandingkan dengan kelompok kontrol sebesar 73,41. Hasil ANCOVA menunjukkan signifikansi 0,000 < 0,05 dengan Partial Eta Squared sebesar 0,308. Nilai N-Gain kelompok eksperimen sebesar 0,597, sedangkan kelompok kontrol sebesar 0,412. Dengan demikian, MMP berbantuan Kahoot berpengaruh positif dan signifikan serta meningkatkan kemampuan pemahaman konsep matematis siswa.
***Kata kunci** : kahoot; kemampuan pemahaman konsep; missouri mathematics project; sistem persamaan linear tiga variabel*

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Introduction

Education has a significant contribution to the development of students' knowledge, competencies, and thinking skills (Harahap, Nasution, & Mandasari, 2025). Mathematics is one of the disciplines that supports the development of these abilities by encouraging students to engage in conceptual, logical, analytical, and systematic thinking (Ansya & Salsabila, 2025). Despite its importance, SPLTV is often perceived as a challenging topic by students. Difficulties may arise when students are required to connect mathematical concepts with appropriate problem-solving procedures.(Baina, Machmud, & Abdullah, 2022), found that students' conceptual understanding of SPLTV remained relatively low. This condition suggests that many students still depend on memorizing formulas and solution steps without fully comprehending the fundamental ideas behind them. Such an approach can limit students' ability to apply mathematical knowledge when facing problems that differ from routine exercises. Therefore, conceptual understanding should receive greater attention in mathematics learning, as it enables students to connect mathematical ideas, select appropriate strategies, and apply concepts meaningfully (Masroh & Rahmadani, 2026).

According to the National Council of Teachers of Mathematics (Cahani, Effendi, & Munandar, 2021), The ability to understand mathematical concepts is the main foundation of mathematical learning. This ability emphasizes not only mastery of formulas but also an understanding of mathematical concepts and their relationships. Then, Moreno (Nuriah, Aripin, & Rohaeti, 2023), explained that conceptual understanding is a student's ability to grasp the meaning, concepts, situations, and facts they have learned. Students with good conceptual understanding not only understand the material they are studying, but also understand the steps they need to take and are able to apply those concepts in various contexts, both inside and outside of mathematics learning. Meanwhile, Zulkardi(Rohmah, Hilyana, & Ermawati, 2024), defines mathematical conceptual understanding as a student's ability to accurately solve various mathematical problems. Based on these various opinions, it can be concluded that mathematical conceptual understanding is a basic competency that every student must possess. This ability encompasses conceptual mastery of material as well as the ability to understand the meaning, relationships, and application of mathematical concepts, enabling students to use this knowledge appropriately to solve various problems.

However, students' mathematical conceptual understanding in Indonesia remains a serious challenge. According to (OECD, 2023) results PISA (2022) results, the average mathematical literacy score for Indonesian students was only 366, far below the OECD average of 472. This indicates that most students still experience difficulties in interpreting information, understanding mathematical concepts, and applying knowledge to solve problems. This condition indicates that mathematics learning in Indonesia still faces significant challenges, particularly in improving students' mathematical conceptual understanding. One cause is the learning process, which is still dominated by lecture methods and teacher-centered procedural exercises. As a result, students are more likely to memorize steps to solve problems rather than understand the underlying concepts and principles (Yanto & Rahaju, 2024).

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Based on observations conducted by researchers at SMA Negeri 1 Selesai, initial observations revealed that students' understanding of the concept of systems of linear equations in three variables is still suboptimal. Students are accustomed to memorizing procedures or steps for solving problems, but do not truly understand the concepts, resulting in difficulties when the problems are presented in a different format. Furthermore, learning is still teacher-centered, resulting in students being less active in asking questions and discussing. Technology-based learning media have not been utilized effectively, resulting in a less engaging learning process and a decline in student learning enthusiasm. The learning model used so far has not fully supported students in building a deep understanding of concepts.

The findings are reinforced by the results of the diagnostic questions from 35 students on the indicator of mathematical concept understanding ability. In the first indicator, as many as 11 students (31.43%) experienced errors in restating the concept. In the second indicator, there were 17 students (48.57%) students who made errors in classifying objects, while in the third indicator as many as 20 students (57.14%) experienced errors in representing concepts in various forms of representation. Furthermore, in the fourth indicator, 18 students (51.43%) were found to have made errors in applying concepts according to the solution procedure, and in the fifth indicator, 15 students (42.86%) experienced errors in connecting the concepts learned with everyday life. These results indicate that errors in understanding concepts are still found in all observed indicators, with the highest percentage of errors in the third indicator.

These issues highlight the need for a learning model that focuses on conceptual understanding and actively engages students. One relevant learning model solution to address this issue is the Missouri Mathematics Project. This model is designed with clear learning stages: review, concept development, controlled practice, independent practice, and assignments. It emphasizes providing practice in stages so students can grasp concepts before working on problems independently (Aulina, Andinasari, & Nopriyanti, 2021). The aim is to help students understand the material taught by the teacher better (Gunadi, Rachmawati, & Hadi, 2020). The implementation of the Missouri Mathematics Project model has a positive impact on improving students' mathematical abilities through systematic learning that focuses on student activities (Neneng M., Muin, & Kustiawati, 2025).

One technology that can be used in mathematics learning is Kahoot. This educational game allows students to actively participate in learning through interactive quizzes. Using this application can increase student motivation and interest, as well as reduce anxiety(Artika, Mahartika, & Irdamisraini, 2024)..The use of technology in the form of interactive media in learning can help increase student engagement and motivation. The use of digital application-based media can create a fun learning environment and encourage students to be more active in understanding concepts.

Additionally, Kahoot in mathematics teaching can also improve learning outcomes and student engagement. With an attractive interface, time limits, and a positive competitive spirit, students become more focused and enthusiastic in answering questions. This encourages students to think quickly and accurately and deepens their understanding of the material being taught. With Kahoot, the learning

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atmosphere becomes more exciting and less boring, because students can learn while playing (Azizah & Ritonga, 2023).

Previous research according to (Ervinasari & Astuti, 2023), testing the Missouri Mathematics Project learning model can improve students' mathematical concept understanding ability compared to using conventional learning. Other research according to(Rachma, Arissona, & Nugroho, 2025), explains that there is a significant influence of the application of the Missouri Mathematics Project learning model on the ability to understand concepts, especially on the material on plane figures. Furthermore, according to (Santoso & Widiyanti, 2022), tested the effectiveness of Kahoot in technology-based learning and interactive activities were able to significantly improve students' understanding of mathematical concepts. Other research according to(Suleman, Arifin, & Kudus, 2024), studied Kahoot as a learning medium that can increase elementary school students' learning motivation and found that its implementation has a positive impact. Then, another study (Oktaviani, Aima, & Melisa, 2026) tested that the use of Kahoot media on MTs students' understanding of mathematical concepts and obtained positive results (Aliyah & Kusumadewi, 2026), testing Kahoot on elementary school students' mathematical concept understanding can improve students' mathematical concept understanding where Kahoot is used in the learning model. However, previous research positions Kahoot as a learning medium used separately from the Missouri Mathematics Project model. Thus, previous research has provided evidence regarding the potential of the Missouri Mathematics Project and Kahoot separately, but has not examined the integration of the two in a single learning process to improve students' mathematical concept understanding.

This research gap became the basis of this study, namely integrating Kahoot into the Missouri Mathematics Project model. This integration allows for a systematic Missouri Mathematics Project learning stage that is not only oriented towards providing materials and exercises, but also supported by interactive activities through Kahoot to increase student engagement in understanding and strengthening mathematical concepts. Therefore, this study differs from previous studies because it does not only test the effect of the Missouri Mathematics Project or Kahoot separately, but rather combines the Missouri Mathematics Project learning model with the Kahoot application as a learning medium to improve high school students' mathematical concept understanding abilities, especially the material on systems of linear equations in three variables.

Based on the description of previous research, this study aims to analyze the influence of the Missouri Mathematics Project learning model assisted by Kahoot on students' mathematical concept comprehension and determine the extent of the influence it has on these abilities. It is hoped that the results of this study can contribute to teachers developing more effective, innovative, and appropriate mathematics teaching methods that meet the needs of learning in the digital era.

Research Methods

This study used a quantitative approach with a quasi-experimental method through a pretest–posttest control group design. In this design, both groups were first given a pretest to determine their initial abilities. Next, the experimental group received treatment, while the control group underwent learning without treatment.

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After the learning process was completed, both groups were given a posttest to measure changes in their abilities (Creswell & Creswell, 2018). The sample determination was carried out using the cluster random sampling technique through a lottery system, which is a sampling technique where the population is divided into groups (clusters), then the groups are selected randomly using a lottery method, and all members in the selected group automatically become research samples (Sakir, 2024).

The research was conducted at SMA Negeri 1. It was completed in the even semester of the 2026/2027 academic year, starting from May 11 – May 29, 2026. The research was conducted during two meetings with a time allocation of 2 x 45 minutes for each meeting.where the control class (X-MIA 10) without treatment followed regular (conventional) learning while the experimental class was given the Missouri Mathematics Project learning model treatment assisted by Kahoot, two meetings were sufficient to measure the ability to understand mathematical concepts because

These abilities were measured through a test instrument that included indicators of comprehensive conceptual understanding, a pre-test, and a post-test in the experimental and control classes. Thus, the measurability of the abilities was determined by the suitability of the instrument and the indicators being measured.. In addition, the implementation of the structured Missouri Mathematics Project learning model also forms the basis for students' conceptual understanding. Its implementation at the review stage is carried out using Kahoot by recalling the prerequisite material for the three-variable linear equation system. The development stage uses Kahoot to present material and questions and facilitate conceptual understanding interactively. At the guided and controlled practice stages, Kahoot is used to provide practice and direct feedback. Furthermore, the assignment stage is carried out using student worksheets so that students not only demonstrate understanding through digital responses but are also able to apply their understanding through written problem solving. Therefore, in order for the implementation of the learning model to run optimally, the support of interesting and interactive learning media is needed. The use of Kahoot in this study was used as a supporting learning media.

The research population consisted of all 390 class X students. The sample was selected from 10 available classes where all class X were drawn twice, for the first time as the experimental class obtained class X-5 and the second time as the control class obtained class X-5, each totaling 34 students.

The research procedure includes three stages, namely: (1) the preparation stage which includes coordination with schools, determining sample classes, preparing Kahoot-assisted learning devices, and validating instruments; (2) the implementation stage in the form of providing learning to both classes according to the predetermined treatment accompanied by monitoring the learning process; and (3) the final stage in the form of collecting and analyzing research data.

The research instrument is in the form of a mathematical concept understanding ability test which is compiled based on indicators according to (Killpatrick, Swafford, & Findell, 2001), namely: (1) restating the concept, (2) classifying objects, (3) representing the concept in various forms of representation, (4) applying the concept according to the solution procedure, and (5) connecting the

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concepts learned with everyday life. The research instrument is a mathematical concept understanding ability test in the form of 5 descriptive questions, each sub-question is given a maximum score of 4, so that the maximum value is 20.

Scoring is adapted from the conceptual understanding rubric on a scale of 0-4 (Nurfadila, Setiani, & Hadi Fs, 2022), namely a score of 4 for a correct and complete answer, a score of 3 for a correct but incomplete answer, a score of 2 for an incomplete answer, a score of 1 indicating an answer but incorrect, and a score of 0 for not answering. The final score is obtained by adding up the scores of all 5 questions, so the maximum score is 5 x 4 = 20, with the formula (Sugiyono, 2019) : $Nilai = \frac{skor\ yang\ diperoleh}{skor\ maksimum} \times 100$

Before being used, the instrument has undergone a validity test with its testing and reliability test to ensure its suitability with testing criteria > 0.06, the instrument trial was conducted in class XI - MIA 5 because these students have become the focus of research in class X. The selection of a class that is different from the research subjects aims to avoid previous experience with the instruments used in the research and to obtain the data needed to test the validity and reliability.$r_{hitung} > r_{tabel}$. Validity test results are shown in Table 1.

Table 1. Validity Test Results

Question No.	r_{hitung}	r_{tabel} $(n = 35 ; a = 0,05)$	Criteria
1	0.775	0.3246	Valid
2	0.830	0.3246	Valid
3	0.841	0.3246	Valid
4	0.868	0.3246	Valid
5	0.760	0.3246	Valid

Based on the table. 1 results of the item validity test, it can be seen that all items were declared valid. This is evidenced by the value of. This indicates that the instrument used is capable of measuring the ability to understand mathematical concepts.$r_{hitung} > r_{tabel} a = 0{,}05$. Reliability test results are shown in Table 2.

Table 2. Reliability Test Results

Cronbach Alpha	N of items	Category
0.873	5	Tall

Based on Table 2, the reliability test results of the research instrument showed a Cronbach's Alpha value of 0.873 was obtained. The test consisted of five items. This Cronbach's Alpha value indicates a very high level of reliability, exceeding the minimum reliability threshold of 0.60. This indicates that the research instrument exhibits excellent consistency in measuring the research variables.

Data analysis was conducted using descriptive statistics to describe the characteristics of the data in both data groups, followed by prerequisite tests in the form of the Shapiro–Wilk normality test because the sample was <50, namely 34 students, with the test criteria of sig> 0.05. and Levene's homogeneity test with the test criterion of sig> 0.06. After the prerequisites were met, the research hypothesis was analyzed using the One-Way ANCOVA test used to test whether there was an influence of the independent variable (treatment) on the dependent variable

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(outcome), by controlling the influence of the covariate variable (usually the pre-test value).

Based on the testing criteria, if the significance value (sig) is greater than 0.05, then H_0 is accepted and H_a is rejected; conversely, if the significance value (sig) is less than 0.05, then H_0 is rejected and H_a is accepted (Sakir, 2024).

Next, the Partial Eta Squared test is used to determine how much influence the independent variable has on the dependent variable after controlling for the covariate (pretest value).

The N-Gain test is used to measure or compare improvements in student learning outcomes before and after the learning process. N – Gain Value Criteria : $\geq 0{,}7$ $Tall$, $0{,}30 - 0{,}70$ $Currently$, $0{,}00 - 0{,}29$ Low (Guntara, 2021).

Results and Discussion

This section presents statistical findings that were used for research purposes. Based on indicators of mathematical conceptual understanding, information from the treatment group test, which was not analyzed, provides an overview of the research data. Descriptive Statistics shows are shown in Table 3.

Table 3. Descriptive Statistics

Class	N	Range	Min	Max	Mean	SD	Difference
Pretest Control	34	27	40	67	53.00	7,966	20.4
Posttest Control	34	22	60	82	73.41	5,566	
Experimental Pretest	34	24	41	65	52.21	6,246	28.7
Experiment Posttest	34	21	70	91	80.94	5,836	

Based on the Table 3, results descriptive statistic average pretest score for the control class was 53.00, and for the experimental class was 52.21. After the learning process, the average posttest score for the control class increased to 73.41, while the experimental class increased to 80.94. Descriptively, the average increase in the control class's score was 20.4 points, while the experimental class's score was 28.7 points. This indicates that the average increase in the experimental class's score was higher than that of the control class. Furthermore, the differences were analyzed using a t-test, while the magnitude of the influence was analyzed through effect size and ability improvement using N-gain.

Next, the normality prerequisite test is used to determine the normality of the experimental class and the control class. The calculation is obtained from the pre-test and post-test values of each class. Normality test results shows in Table 4.

Table 4. Normality Test Results

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistics	Df	Sig.	Statistics	Df	Sig.

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Pre-test of Control Class	.134	34	.129	.940	34	**.063**
Control Class Posttest	.148	34	.057	.946	34	**.095**
Experimental Class Pretest	.226	34	.000	.942	34	**.072**
Experimental Class Posttest	.152	34	.044	.950	34	**.126**

Based on the table. 4 results of the normality test using Shapiro-Wilk in Table 2, the pretest significance value for the control class was 0.063 > 0.05, so the pretest data for the control class was normally distributed. Furthermore, the posttest significance value for the control class was 0.095 > 0.05, so the posttest data for the control class was normally distributed. In the experimental class, the pretest significance value was 0.072 > 0.05, so the pretest data for the experimental class was normally distributed. Meanwhile, the posttest significance value for the experimental class was 0.126 > 0.05, so the posttest data for the experimental class was also normally distributed. Thus, all pretest and posttest data in the control and experimental classes were normally distributed because all significance values were greater than 0.05.

The homogeneity test is intended to determine whether the data have the same variance (variance) or not. The data is declared homogeneous if the sig. value is based on the mean. Results of Homogeneity Test shows in Table 5.

Table 5. Results of Homogeneity Test

		Levene Statistics	**df1**	**df2**	**Sig.**
Results	Based on Mean	.000	1	66	**.986**

Based on Table 5, the results of the homogeneity test using the Levene statistical test, obtained a Sig Based on Mean value of 0.986, which is greater than 0.05, so it can be stated that the variance of the research data is homogeneous. This means that the data used in the study has a relatively equal level of distribution and diversity between data groups. So the values of the two classes have homogeneous variance values.0,986 > 0,05)

Furthermore, the results of the hypothesis test, namely One-Way ANCOVA, are shown in the following table. One-Way ANCOVA test results in Table 6.

Table 6. One-Way ANCOVA Test Results

Tests of Between-Subjects Effects

Dependent Variable: Posttest

Source	**Type III Sum of Squares**	**Df**	**Mean Square**	**F**	**Sig.**	**Partial Eta Squared**
Corrected Model	975.427a	2	487,714	14,852	.000	.314
Intercept	7734.298	1	7734.298	235,531	.000	.784

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Pre-test	11,662	1	11,662	.355	.553	.005
Model	948,855	1	948,855	**28,895**	**.000**	**.308**
Learning						
Error	2134.455	65	32,838			
Total	408132.000	68				
Corrected Total	3109,882	67				

Based on the table. 6, results of the One-Way ANCOVA analysis, the F value of 28.895 indicates that there is a fairly big difference in the ability to understand mathematical concepts between the learning groups after the pretest scores of the control and experimental classes. This is indicated by the Sig. value = 0.000 < 0.05, indicating that the difference is statistically significant. Thus, the implementation of MMP assisted by Kahoot has been proven to have a significant influence on students' ability to understand mathematical concepts.

The Partial Eta Squared value of 0.308 indicates that the learning model has a large influence of 30.8% on students' ability to understand mathematical concepts. N – Gain Test Results are shown in Table 7.

Table 7. N – Gain Test Results

Experimental Class		**Control Class**	
Mean N Gain	0.597	N Gain	0.412
Percentage	59.7	Percentage	41.2
N Gain		N Gain	
Category	**Currently**	**Category**	**Currently**

Based on the table. 7 results of the mean N-Gain of the experimental class obtained was 0.597 or 59.7% and is included in the moderate category. And the results of the mean N-Gain in the control class, obtained an N-Gain value of 0.412 or 41.2% also included in the moderate category. Although in both classes are the same category, the increase in the experimental class is higher than the control class. This gap shows the substantial contribution of the Missouri Mathematics Project learning model assisted by Kahoot in strengthening students' mathematical concept understanding abilities.

Through the results of the hypothesis test analysis that has been carried out, it has been proven by (Tambunan & Tambunan, 2023), that there is a significant influence on the ability to understand mathematical concepts between students in the experimental class who received the Missouri Mathematics Project model assisted by Kahoot and the control class who received the conventional learning model and there is a difference in the ability to understand mathematical concepts between students who received the Missouri learning model Mathematics Project Kahoot-assisted learning model with students who received a conventional learning model. This finding indicates that the application of the Missouri Mathematics Project model assisted by Kahoot has a positive and significant influence on the ability to understand mathematical concepts of class X – MIA 5 students at SMA Negeri 1 Sering. This is in line with the cognitive learning theory; this model is designed with a structured syntax, namely review (review of previous material),

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concept development, guided practice (group work), independent practice, and homework that actively involve students in the learning process. In contrast to the usual (conventional) learning model where students tend to be passive recipients of information, the Missouri Mathematics Project model builds their own conceptual understanding through discussion, collaboration, and independent practice. Confirmed by the study (Ervinasari & Astuti, 2023), confirmed that the operation of the Missouri Mathematics Project model resulted in a higher average level of conceptual understanding in the experimental class than in the control class.

Furthermore, using the Kahoot app as a learning tool helps students understand the material through engaging and interactive displays. Kahoot's features, such as learning materials, practice problems, and educational games, make the learning process more enjoyable and less monotonous. The use of digital media also increases interest and motivation in learning, making it easier for students to grasp the concepts being studied. The combination of the Missouri Mathematics Project model and the Kahoot app creates an active, collaborative, and engaging learning environment. In line with the study (Juliani, Erita, & Anggraini, 2025), using Kahoot in learning creates a more lively learning environment, improves responsiveness, and enhances conceptual understanding thanks to the immediate feedback provided by quizzes. Another study found that using Kahoot as a learning medium in the form of interactive quizzes has proven highly efficient.

The advantages of the Missouri Mathematics Project learning model in improving conceptual understanding can be further explained through its learning steps. The review stage (Artika et al., 2024), Concept development, and guided and independent practice using Kahoot are used by both students and teachers; at the assignment stage, students are given questions using student worksheets so that students can better master the material given. This activity trains students to restate concepts, classify objects, present concepts in various representations, apply concepts according to solution procedures, and connect concepts that have been learned with everyday life. Active processes like this rarely occur in the control class considering that learning is dominated by teacher explanations in front of the class.The study took place in two sessions for each class, with a time allocation of minutes for each session per category. While the control class was given a conventional model, the experimental class applied the Missouri Mathematics Project model supported by interactive media, Kahoot. The learning approach, which incorporates sequential work steps and the use of digital platforms, provided essential learning experiences. These conditions provided opportunities for in-depth learning and direct feedback during the activity. 2×45

Thus, this finding provides strong empirical evidence that the choice of learning model used has a direct impact on student learning outcomes, particularly conceptual understanding. The Missouri Mathematics Project model has been proven to be able to create a more dynamic and student-centered learning environment, which ultimately succeeded in improving the ability to understand mathematical concepts more effectively than conventional learning.

Conclusion and Suggestion

Based on the findings of this study, the implementation of the Kahoot-assisted Missouri Mathematics Project (MMP) learning model was found to have a

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positive and statistically significant effect on the mathematical concept understanding of tenth-grade students at SMA Negeri 1 who finished in learning Three-Variable Linear Equation Systems. The effect size, as reflected by the Partial Eta Squared value of 0.308, indicates a meaningful contribution of the intervention to students' conceptual understanding. Thus, the findings suggest that combining the structured learning stages of the MMP model with interactive activities provided through Kahoot can effectively support students in developing a deeper understanding of mathematical concepts. From a practical perspective, this approach may serve as an alternative strategy for teaching Three-Variable Linear Equation Systems, as it promotes systematic learning while encouraging students to participate more actively in the process of constructing and understanding mathematical concepts. Future research should use a broader sample and consider other variables to obtain more comprehensive results.

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