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# Development of Student Worksheets Assisted by Flipbook Based on the Scientific Approach for Systems of Linear Equations with Two Variables Material

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**Abstract:** The teaching material plays a crucial role in learning, namely by sparking interest so that participants can grasp the material effectively. Students still face difficulties in understanding the teaching material presented in the textbook. This research aims to develop Worksheets Assisted by Flipbook Based on the Scientific Approach to the topic of Systems of Linear Equations with Two Variables for grade VIII C, at Muhammadiyah 9 Yogyakarta Junior High School. The research method used is development, employing the ADDIE model. The research subjects involve two content experts, two media experts, and 30 student respondents. Data collection in this study was carried out through interviews, qualitative observations, and tests, utilizing interview guidelines, rating scales, and tests as data collection methods. Data analysis techniques include qualitative, quantitative, and inferential statistical descriptive analysis. The research results show that the content expert's validity score is 94.23% (very valid), while the media expert gives a rating of 90.00% (very valid), and the student response results in a score of 73 (very interested). Data analysis indicates a two-tailed significance value of 0.000 < 0.05, indicating a significant difference in scores between the pretest and posttest groups. Therefore, it can be concluded that there is a significant difference in mathematics learning outcomes for students after participating in learning using Worksheets Assisted by Flipbook Based on the Scientific Approach to the topic of Systems of Linear Equations with Two Variables, and it has been proven to improve mathematics learning outcomes.

**Keywords:** Student worksheets, flipbook, scientific, systems of linear equations with two variables

## 1. Introduction

Effective teaching materials are those that meet the needs of students according to their proficiency levels, whether high, moderate, or low (Hidayati & Wagiran, 2020). Good teaching materials should also be capable of stimulating students' interest through the use of communicative language and serve as a guide for them to learn independently without the guidance of an educator (Magdalena et al., 2021). However, based on observations at Muhammadiyah 9 Yogyakarta Junior High School, issues related to the currently used teaching materials in the school were identified, specifically the 2013 Curriculum government textbooks without additional supplementary materials. Despite this, students still complain about the difficulty in understanding the content of the book due to the lack of detailed problem discussions and its limitation to classroom use only, without the option to take it home.

As a potential solution to the aforementioned issues, the development of Student Worksheets is considered as one option. Student Worksheets is a collection of printed teaching materials that provide a summary of the content, instructional guidance, and tasks for students to complete (Oktapia & Siregar, 2023; Ilahi et al., 2022). E-Student Worksheets, or electronic Student Worksheets, is also a tool that can support and facilitate learning activities by enabling effective interaction between students and teachers, thereby enhancing student engagement (Hamidah et al., 2023). E-Student Worksheets serves as a learning aid for students, making the learning process more convenient. In addition to using appropriate teaching materials, a teaching approach that responds to students' interests is necessary (Nur'ariyani et al., 2023; Kusumayuni et al., 2021). In this research, Student Worksheets will be presented in electronic form, known as e-Student Worksheets, considering that the majority of students already have personal smartphones. This e-Student Worksheets will be developed in Flipbook format, a web service for converting PDFs into Flipbooks with additional

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features such as videos, images, GIFs, and external links to enhance visual appeal. The development of e-Student Worksheets in Flipbook format intends to engage students' interest, consequently boosting their motivation to learn. (Fina et al., 2022; Rochim et al., 2022).

Furthermore, another obstacle encountered by students is the challenge of comprehending the educational materials presented in the textbook. Therefore, the researcher developed a scientific-based e-Student Worksheets to address this issue. The scientific approach was chosen because it is capable of highlighting students' direct experiences through observation and experimentation, allowing them to generate data or knowledge that can be well-accounted for (Holil, 2023). The scientific approach also emphasizes that the teacher's role is not only as the center of learning but also as a student's learning partner (Lian et al., 2020; Nguyen et al., 2020). The stages in the scientific approach involve five steps, the first of which is the observation activity, where the teacher provides students with the opportunity to observe through listening and reading activities (Syarnubi et al., 2021; Hasanah, 2019). Second, the questioning step gives students ample space to inquire about the learning material (Abidah et al., 2020; Crogman & Trebeau, 2018). Third, the information gathering step involves students in exploring and collecting information from various sources (Kharis & Zili, 2022; Xu & Zammit, 2020). Fourth, the information processing step involves students processing information to discover connections between pieces of information and draw conclusions (Risda et al., 2023; Franisela, 2016). Fifth, the communication step includes activities such as writing or narrating students' findings. The scientific approach can assist teachers in engaging students and enhancing students' scientific thinking abilities (Irwandi & Fajeriadi, 2020)..

This research also innovates by developing Scientific-Based Student Worksheets in an electronic format that can be accessed online using a flipbook. The study will be conducted until the scientifically-based e-module using Flipbook on Systems of Linear Equations with Two Variables material is considered valid, practical, and effective. Based on the issues outlined, the development of e-Student Worksheets is deemed necessary as a solution to these problems, specifically the development of scientifically-based e-Student Worksheets using Flipbook for Systems of Linear Equations with Two Variables material

## 2. Methodology

This type of research is development-oriented, following the ADDIE model, which includes stages of analysis, design, development, implementation, and evaluation (Ardiansah & Miftakhi, 2020). The research participants consist of 2 content experts, 1 instructional media expert, and 1 instructional design expert. Meanwhile, the trial subjects consist of 30 students from Muhammadiyah 9 Yogyakarta Junior High School. This study employs a pre-test-post-test only control design. Data collection methods involve interviews, qualitative observations, and tests. Interviews are used to understand on-field issues from the perspectives of teachers and students. Qualitative observations are used to assess the validity of the developed teaching materials. Tests are used to measure students' abilities following the utilization of e-Student Worksheets with Flipbook assistance based on the Scientific Approach. The content validity of the teaching material grid can be evaluated by reviewing each instrument item using assessments from experts, and the results are analyzed. According to content validity criteria, the content expert attains a content validity coefficient of 1.0 for the instrument, and for the design and media experts, it is 0.91 each, suggesting an exceptionally high degree of content validity. The data analysis process involves qualitative descriptive, quantitative descriptive, and inferential statistical analysis techniques. Qualitative descriptive analysis is used to process data from expert reviews. Quantitative descriptive analysis is used to analyze data obtained from questionnaires in the form of scores. For a clearer interpretation, the Achievement Level Conversion with a 5-point scale is used (Pradiptha & Wiarta, 2021). The effectiveness of teaching materials on learning outcomes is evaluated using the t-test formula, and data normality tests are conducted using the SPSS 25 application. The t-test is conducted utilizing the paired sample t-test technique in the SPSS 25 application.

## 3. Results

### 3.1 Analyze

The development of flipbooks for Scientific-Based E-Student Worksheets on the material of Systems of Linear Equations with Two Variables conducted employing the ADDIE development model. The first stage was analysis, which revealed that the main issue in learning was the lack of instructional materials, impacting students' motivation and learning outcomes. Student responses indicated a need for electronic teaching materials that could address their difficulties in understanding, questioning, gathering information, and communicating. As a solution, Scientific-Based E-Student Worksheets Flipbooks were developed. Curriculum analysis indicated that the material to be used focused on variations in styles in everyday life. This choice was made due to students' difficulties in understanding the material if it was only explained directly without the assistance of teaching materials involving hands-on practice. Therefore, the development of Scientific-Based E-Student Worksheets Flipbooks based on the scientific approach covering the Systems of Linear Equations with Two Variables material was deemed necessary.

## 3.2 Design

The necessary steps in developing e-Student Worksheets involve designing its content using a flowchart and storyboard. To create e-Student Worksheets content aligned with the system flow for users, we utilize a flowchart. The flowchart assists the researcher in identifying the operational processes of the system, especially in explaining each step of its implementation. Generally, the flowchart is created using PowerPoint and Flip PDF Professional applications. The process of creating the e-Student Worksheets product involves three stages. Firstly, Microsoft Word 2016 is used to create the text. Secondly, PowerPoint is utilized to design the appearance of the e-Student Worksheets. Lastly, Flip PDF Professional is employed to merge the elements of the e-Student Worksheets. The design of the developed e-Student Worksheets can be seen in Fig. 1.

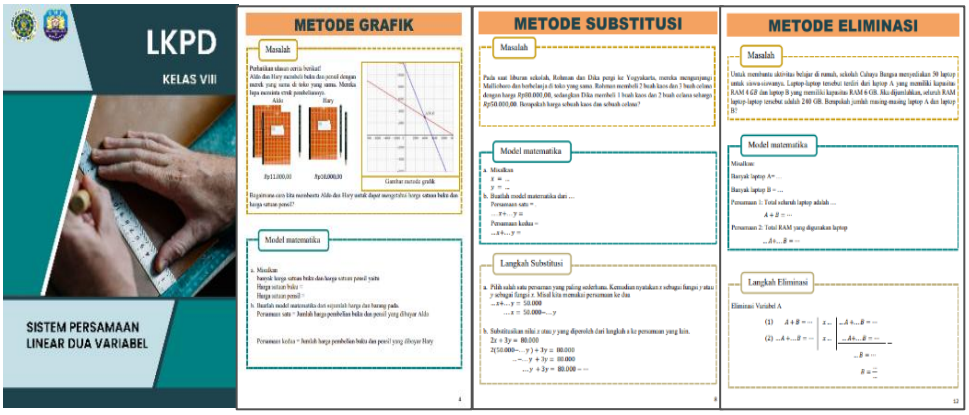


**Fig. 1. Design results of scientific-based e-student worksheets**

## 3.3 Development

In the development stage, the designed Flipbook Student Worksheets will undergo validation by both a content expert and a media expert. The form of the validity interval categories of the Flipbook Student Worksheets and the data generated from the validation test can be seen in Table 2. In this development stage, the product produced is an e-Student Worksheets based on a Flipbook. The initial activities in this stage involve collecting materials for the creation of e-Student Worksheets, such as text and images. The first step uses Microsoft Word 2016 to adjust the text format as a design for developing the text according to the content of the e-Student Worksheets. The second step involves creating the Student Worksheets design using PowerPoint, covering the cover appearance, background, content, and evaluation, utilizing appealing images. These images are developed through PowerPoint. The third step involves converting images and text into a PDF format to prevent them from easily breaking. The content of the e-Student Worksheets is enhanced with animated images. Components of the scientific approach, such as the observation and questioning stages, are present in the content view. The information gathering stage, a component of the scientific approach, is displayed in the "graphic method, substitution method, and elimination method" views. Components of the scientific approach, such as managing information (associating) and communicating information, are present in the conclusion view. The results of this development can be seen in Fig. 2, Fig. 3 and Fig. 4.

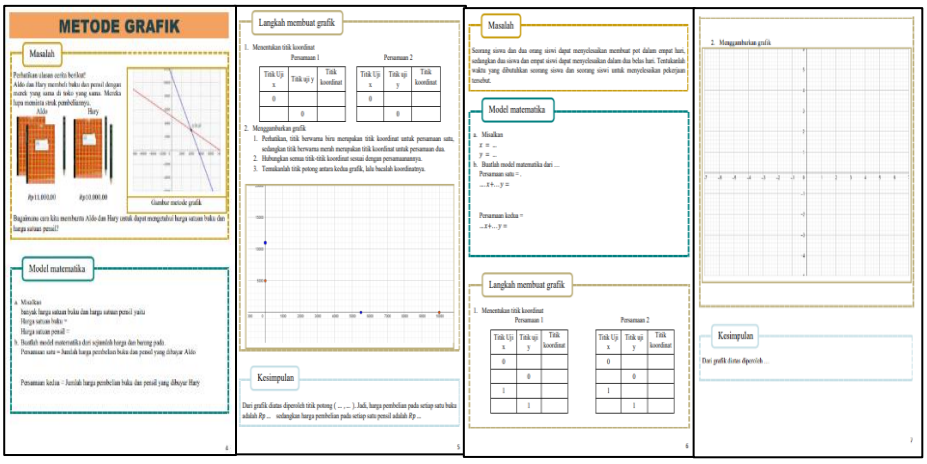


**Fig. 2. Development results on the graphic method sheet**

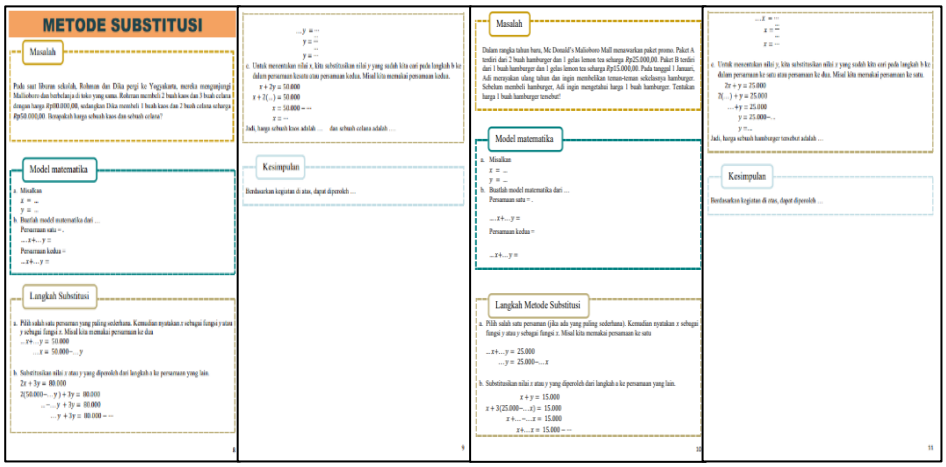


**Fig. 3. Development results on the substitution method sheet**

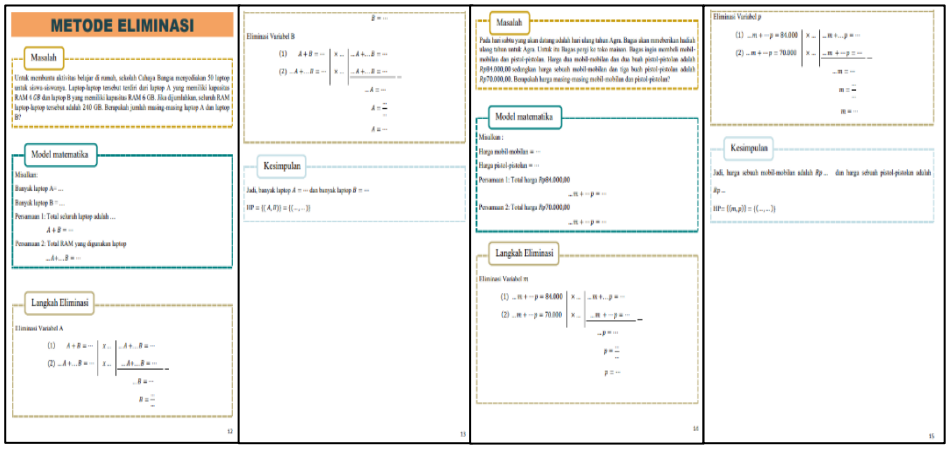


**Fig. 4. Development results on the elimination method sheet**

## 3.4 Implementation

The summary scores from the instructional content expert indicate the content expert's validity. Based on Table 1, it obtains a score of 94.23% from the instructional content expert with the criteria of being highly valid. Therefore, it can be inferred that the e-Student Worksheets supported by a Flipbook with based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material has a highly valid content validity.

**Table 1. Data on validation test results by material experts**

| Aspects | Score | Maximum score |
|---|---|---|
| Fill credentials | 11 | 12 |
| Serving eligibility | 15 | 16 |
| Language | 19 | 20 |
| Compatibility with the approach | 4 | 4 |
| Score | 49 | 52 |
| Percentage | 94.23% | |
| Results criteria | Very Valid | |

Based on Table 2, it attains a score of 90.00% from the media expert with the criteria of being highly valid. In conclusion, the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material meets the criteria of very good qualification.

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**Table 2. Data from validation test results by media experts**

| Aspects | Score | Maximum score |
|---|---|---|
| Language | 14 | 16 |
| Graphics | 28 | 32 |
| Serving Eligibility | 12 | 12 |
| Score | 54 | 60 |
| Percentage | 90.00% | |
| Results criteria | Very Valid | |

Based on Figure 5, 73% of students find the product interesting because the steps provided have clear explanations for solving problems. Additionally, learning using flipbooks in school is a new experience for students. On the other hand, 27% still feel less interested. Upon further evaluation, this is due to some students who, until now, have not fully grasped the basic Systems of Linear Equations with Two Variables material, which is algebra, and are unsure of how to translate real-world problems into mathematical expressions. Overall, it can be inferred that the e-Student Worksheets supported by a Flipbook with based on the Scientific Approach for the systems of linear equations with two variables material appropriate for integration into the learning process.

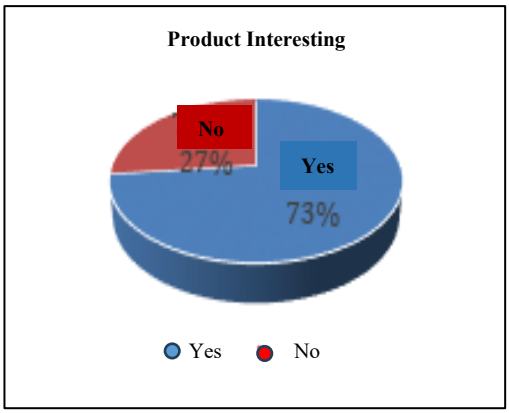


**Fig. 5. Student interest in flipbook student worksheets**

## 3.5 Evaluation

The data in Table 3, described the research results are the mathematics learning outcomes on the Systems of Linear Equations with Two Variables material processed using the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material to evaluate the effectiveness of the product. The results of the pretest and posttest using SPSS 25 produced the following output. Based on the table above, the analysis with the Kolmogorov-Smirnov value and probability (Sig.) for pretest and posttest are 0.093 and 0.200, respectively. With a significance value > 0.05, it can be concluded that the pretest and posttest results have a normal distribution.

**Table 3. Normality test results for pretest and posttest**

| Tests of Normality | | | | | | |
|---|---|---|---|---|---|---|
| | Kolmogorov-Smirnov[a] | | | Shapiro-Wilk | | |
| | Statistic | df | Sig. | Statistic | df | Sig. |
| Pre-test | .148 | 30 | .093 | .959 | 30 | .298 |
| Post-test | .116 | 30 | .200* | .970 | 30 | .538 |

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

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The results of the paired sample test statistics can be seen in the Table 4.

**Table 4. Results of Paired Sample Test Statistics**

| Paired Samples Statistics | | | | | |
|---|---|---|---|---|---|
| | | Mean | N | Std. Deviation | Std. Error Mean |
| Pair 1 | Pre-test | 49.44 | 30 | 15.25 | 2.78 |
| | Post-test | 71.24 | 30 | 16.16 | 2.95 |

Based on the table above, indicating that the average score on the posttest surpasses that of the pretest, namely 71.24 > 49.44. Comparing the probability values (sig.) accomplishes the decision regarding the difference in mean scores between the pre-test and post-test. The results of data analysis reveal a two-way significance value (2-tailed) of $0.000 < 0.05$. This signifies a noteworthy difference in scores between the pre-test and post-test groups. Following the paired sample t-test decision-making criteria, it can be inferred that $H_0$ is rejected, and $H_1$ is accepted. Therefore, it can be inferred that there is a meaningful distinction in the mathematics learning outcomes among eighth-grade students after using the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material.

**Table 5. Results of Paired Sample T-Tes**

| Paired Samples Test | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Paired Differences | | | | | t | df | Sig. (2-tailed) |
| | | Mean | Std. Deviation | Std. Error Mean | 95% Confidence Interval of the Difference | | | | |
| | | | | | Lower | Upper | | | |
| Pair 1 | Pre-test – Post-test | -21.79 | 24.53 | 4.47 | -30.95 | -12.63 | -4.86 | 29 | .000 |

## 4. Discussion

The Flipbook-supported Student Worksheets Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material is a suitable learning tool for the teaching and learning process. Furthermore, there is a meaningful distinction in the mathematics learning outcomes among eighth-grade students after using the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material, for the following reasons.

Firstly, the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material is capable of improving learning outcomes. This e-Student Worksheets can effectively assist teachers in transferring knowledge to students (Putri & Amini, 2023; Putra et al., 2023; Yulanda et al., 2023). The use of teaching materials combined with technology can facilitate students' learning processes, consistent with findings stating that digital teaching materials can enhance student learning outcomes (Desyandri et al., 2021; Hanif, 2020; Simamora, 2020). Due to the rapid progress of science and technology, teachers can leverage this to support online learning activities (Ferri et al., 2020; Simamora et al., 2020). Therefore, the development of e-Student Worksheets that align with students' needs becomes an essential factor to consider. E-Student Worksheets also serve as learning aids for students, facilitating the learning process (Matondang et al., 2023; Wijaya et al., 2023). The organization of sentences in e-Student Worksheets is done neatly, facilitating ease for students in comprehending the learning material.

Secondly, the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material can increase student motivation. The attractive design of this e-Student Worksheets can motivate students. E-Student Worksheets also serve as a supporting tool that facilitates learning activities by enabling effective interaction between students and teachers, thus enhancing student participation (Rosidah et al., 2023; Widyawati et al., 2022). A student-oriented scientific approach, rather than teacher-centric, can improve students' learning motivation (De Loof et al., 2021; Fortus & Touitou, 2021). The inclusion of images in digital Student Worksheets provides additional appeal, boosting learning motivation (Tarisna et al., 2023). Ease of use of digital Student Worksheets can also enhance student motivation, aligning with findings that ease of media use improves student motivation (Alhrahsheh, 2024; Suripah & Susanti, 2022).

Thirdly, the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material can create enjoyable learning experiences. The integration of the scientific approach in this e-Student Worksheets stimulates student engagement and creates a pleasant learning atmosphere. The scientific approach creates a space that allows students to actively engage in learning (Zen, 2017). Through digital e-Student Worksheets, various methods in Systems of Linear Equations with Two Variables, such as graphs, substitution, and elimination, can be presented, giving students the opportunity to build their knowledge and create enjoyable learning

experiences. The steps of the scientific method, including observation, questioning, gathering information, processing information, and communicating, make learning activities more lively and enjoyable (Supena et al., 2021; Husni, 2020). Previous research outcomes also indicate that the scientific approach helps teachers involve students effectively, leading to increased student learning activity (Supena et al., 2021; Almulla, 2020).

## 5. Conclusion

In conclusion, the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material can be an effective learning aid in the teaching and learning process. The implications of this research are that the developed Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material is applicable for both educators and learners. With the existence of this e-Student Worksheets, it is expected to enhance student motivation and create a better learning atmosphere, ultimately impacting improved student learning outcomes. The Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material, which adopts a scientific approach, received excellent ratings from experts, teachers, and students, making it considered suitable for use in the learning process. Additionally, there is a significant difference in mathematics learning outcomes for eighth-grade students at Muhammadiyah 9 Yogyakarta Junior High School after using the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material. Therefore, it can be concluded that the Student Worksheets Assisted by Flipbook Based on the Scientific Approach for the Systems of Linear Equations with Two Variables Material is capable of enhancing the achievement of learning outcomes for eighth-grade students at Muhammadiyah 9 Yogyakarta Junior High School.

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## Conflict of Interest

The authors declare no conflicts of interest.

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