



## Practicality of Treffinger Model-Based Linear Program Student Worksheets in Grade XI High School

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**Abstrak:** Masalah yang terjadi pada pembelajaran matematika seringkali disebabkan oleh materi matematika yang abstrak, sehingga sulit bagi peserta didik untuk memahaminya terutama pada materi program linear. Peserta didik dituntut untuk mampu memahami kalimat pada soal dan mengubahnya menjadi model matematika, serta mampu membuat dan membaca grafik. Materi yang abstrak ini perlu dipoles dengan penyampaian tulisan yang mengajak belajar serta tampilan yang menarik, dengan begitu penyampaian materi mampu dipahami oleh peserta didik. Salah satu solusi yang diberikan ialah dengan membuat lembar kerja peserta didik (LKPD) yang berbasis model treffinger yang praktis agar dapat diterapkan dalam kegiatan pembelajaran matematika pada materi program linear. Jenis penelitian ini yaitu Research and Development (R&D) dengan menggunakan model 4-D yaitu Define, Design, Develop, dan Disseminate. Penelitian dibatasi sampai pada tahap develop dikarenakan hanya melakukan uji praktikalitas. Pengambilan data praktikalitas dilakukan dengan memberikan angket respon kepraktisan kepada seorang guru matematika dan 27 orang peserta didik kelas XI di SMA Kota Medan, Sumatera Utara. Penelitian sebelumnya menunjukkan bahwa tahap define, design, dan develop telah teruji dengan hasil kevalidan dinyatakan sangat valid. Hasil uji praktikalitas pada peserta didik diperoleh sebesar 3,6 dengan kategori praktis. Demikian bahwa LKPD berbasis model treffinger praktis digunakan dalam kegiatan pembelajaran matematika pada materi program linear.

**Kata kunci:** LKPD; model treffinger; praktikalitas.

**Abstract:** Problems that occur in mathematics learning are often caused by abstract mathematical material, making it difficult for students to understand, especially in linear program. Students are required to be able to understand the sentences in the problem and convert them into mathematical models, as well as being able to create and read graphs. This abstract material needs to be polished with the delivery of writing that invites learning and an attractive appearance, so that the delivery of material can be understood by students. One of the solutions provided is to make worksheets based on the practical Treffinger model, so they can be applied in mathematics learning activities on linear program. This type of research is Research and Development (R&D) using the 4-D model, namely Define, Design, Develop, and Disseminate. Research was limited to the development stage due to the practicality test only. Practicality data were collected by giving a practicality response questionnaires to a mathematics teachers and 27 student grade XI at SMA in Medan City, Sumatera Utara Province. The previous research show that the define, design, and develop stages have been tested with the results of the validity declared very valid. The results of the practicality test on students were obtained at 3.6 with the practical category. Thus, the LKPD based on the Treffinger model is practically used in mathematics learning activities on linear program.

**Keywords:** student worksheets; treffinger model; practicality.

## **Introduction**

Mathematics is the science and study of quantity, structure, space, and change. According to Depdiknas (Departemen Pendidikan Nasional, 2006), mathematics is the study of something that has abstract objects and is built through a deductive thinking process, which derives a concept of truth from the results of previously accepted logical consequences that the relationship between mathematical concepts is very strong and clear. Also explained by Marsigit (Pioke et al., 2022) that the collection of truth values of the concept is expressed in the form of a statement equipped with evidence. So, that abstract concept is represented by a symbol with reasoning and can be applied in solving problems related to number.

The problems that related to numbers, especially abstract concept, are generally difficult for students to understand. If students feel that mathematics is difficult to learn and understand, then the interest of students to learn mathematics will be lost (Alfiansyah & Rusmining, 2023). So that students will ignore every explanation presented by teacher. This will affect the learning achievement of students at school. However, mathematics needs to be learned by students because it will be very useful for everyday life (Muhammad & Yolanda, 2022). The reason for the need to study mathematics is because it is useful, both in real life and as a language and tool in the development of science and technology. Furthermore, according to Shadiq (Khairunnisa et al., 2022) mathematics helps learners create new ideas, adapt to change, face uncertainty, and follow rules, and solve unusual problems. Mastery of mathematics material for students is non-negotiable in shaping reasoning and decision making (Whitney-Smith et al., 2022). Because of these benefits, mathematics deserves to be a subject taught to students.

The student at all levels of education, must be learning mathematics because of its role as an introduction to other sciences. Seeing the abstract nature of mathematics, it requires to have high reasoning power. Similarly, in teaching mathematics, teachers must be able to process and interpret mathematical objects well so that students can understand the mathematical objects taught. Learning mathematics is a mental activity (Proulx, 2019), where student enable to develop new and economical ways of solving problems. So that in teaching, teachers must be able to provide good explanations so that abstract mathematical concepts are easily understood by students.

In addition to providing good teaching and explanation, appropriate teaching materials are also needed to optimize learning activities. One of the teaching materials that can optimize learning is student worksheet (LKPD). Student worksheets are task sheets that must be done by student and used to investigate and solve the problem (Nasution et al., 2021; Ramadhan et al., 2021). The use of student worksheet is sought to be able to improve student learning activities (Huda et al., 2022). The findings obtained by researchers in the results of a preliminary study in one of the high schools in Medan District, Sumatera Utara Province, conducted by distance learning, obtained information that teachers regretted that teaching materials in the form of mathematics student worksheet given by the school were not suitable for the needs of students. The information obtained from students is also the same, the assignments given from teachers are sourced from student worksheet, but the material given by teachers is higher and clearer than those in the student worksheet. The content in the student worksheet is also less varied and interesting, said students. Researchers look at the availability of learning resources in the form of package books and worksheets that are available and used as sources of teaching materials that are quite adequate. However, researchers found weaknesses in the preparation of worksheets.

The weaknesses in the student worksheet are identified that the cover worksheet has a color design and writing that is less attractive and does not contain student identity columns. It was found that the worksheet did not contain learning indicators. Learning indicators are one of the important elements in a worksheet (Fauziah & Nurita, 2019). In addition, the

worksheet also does not contain a summary of each sub material. The summary on the worksheet is presented to support distance learning, so that students are able to align the conclusions of the material obtained according to the core of learning. Student worksheet is a thing used by students in learning that can connect interactions between students and teacher. So that worksheet can minimize student learning problems (Umbaryati, 2016). Such is the case with the student worksheet used in the school. Although mistakes do not escape humans, improvements and developments also need to be improved.

One solution that can be used to improve the quality of worksheets is to present worksheets with a learning model, namely using the Treffinger model. The Treffinger model is one of the few models that addresses the problem of creativity and provides practical suggestions for achieving cohesiveness (Munandar, 2016). The Treffinger model seeks to integrate the cognitive and affective aspects of students looking for a solution direction to be used in solving a problem (Rahmawati, 2015). Solving problems that are generally done systematically, but with stages on the Treffinger can be processed imaginatively through information processing. Information processing involves obtaining information, understanding information, and using that information to solve a problem.

The use of student worksheet based on the Treffinger model in learning mathematics provides good results. Azahar, et al. (2023) revealed that the math module with the Treffinger model setting on transformation material obtained a level of practicality of 91.33%. The development of student worksheet with the Treffinger model was also carried out by Rangkuti (2022) on quadrilateral and triangle material. The student worksheet provides practicality results of 90% with a very good category. In the same year, Lukito (2022) also developed student worksheet based on the Treffinger model on cube and beam material. The practicality test results obtained an average score of 165.67 with a very good category. Thus, the efforts made by researchers to overcome the problem of presenting worksheets using the Treffinger model.

Based on the explanation previously disclosed and the theoretical assessment that has been carried out by researchers, there is still little research on student worksheet based on the Treffinger model, especially on linear program. Researchers attempt to present worksheet based on Treffinger model for linear program material. Linear programs are closely related in real-life aspects and abstract material discussions. So that with the help of the Treffinger model, learning mathematics linear program material can be easily understood and created by students in independent learning activities on distance learning.

## **Method**

The research used research and development (R&D) method by applying a 4-D design model from Thiagarajan. The stages in the 4-D model include the define, design, develop, and disseminate stage (Mayasari et al., 2022; Priciliya et al., 2022). This research was conducted to see the practicality of Treffinger model-based the student worksheet, so that the stages were only the define, design, and develop.

The define stage was determined the purpose of making the product to be developed, through the stages of front-end analysis and student analysis. The purpose of the development will be the basis that will be developed in the form of teaching materials that will be used during the learning process. The teaching material in this study were student worksheets based on the Treffinger model. After determining the product development purpose, then collect information related to the concept of the material and learning purpose on the linear program material that will be used in student worksheets according to core competencies and basic competencies.

The design stage was carried out by designing the product to be developed. The product design consists of media selection and format selection. In the media selection, it aimed to

determine the learning media to be developed, namely the student worksheets based on Treffinger model. While at the format selection stage, it aimed to design the parts that will be presented in the worksheets. Parts arranged in student worksheets such as cover and identity of worksheets, foreword, instructions for using worksheets, components of the Treffinger model, table of contents, concept map, content material, practice questions, assignments, and bibliography. By using blue, red, and orange as the main colors of student worksheet as well as the use of images in Treffinger model components. The developed worksheet consists of three units. Unit I worksheet contained a linear inequality system of two variables, Unit II worksheet contained model mathematics, and Unit III worksheet contained optimum values in linear programs.

The develop stage was carried out to see the results of validity, practicality, and effectiveness of the developed product. In this study, the worksheet that would be developed only reached the phase of practicality which would be determined by the practicality of the product by students. Products that have been validated determined whether or not the product was appropriate to be given to teachers and students.

The instrument used in this study was a questionnaire of student worksheet usability response given to a mathematics teacher and 27 students of grade XI. Data analysis techniques were carried out qualitatively and quantitatively. Qualitative data in the form of criticism, responses and suggestions for improvement contained in the questionnaire worksheets of students developed. Quantitative data in the form of numerical data obtained from questionnaires. The following Table 1 presents the aspects and indicators of practicality questionnaire assessment (Safenita et al., 2023).

Table 1. Practicality Questionnaire Presentation Indicators

Aspects	Indicators
Contents of material	The suitability of the syntax of the presentation technique with the learning model Use appropriate language and sentences
Ease of use	Activities in worksheet are clear and systematic Have an identity to facilitate the use of worksheet
Attractiveness of appearance	Having a variety of stimuli through various media and activities Invite students to be active in learning Illustrations can clarify and facilitate understanding
Use of models	The effectiveness and efficiency of the model in the learning activities The accuracy of the model in presenting the material

The criteria for evaluating the questionnaire use a Likert calculation scale of 1-5 are presented in Table 2 (Safenita et al., 2023).

Table 2. Practicality Questionnaire Assessment Scores

Category	Score
Very good	5
Good	4
Pretty good	3
Not bad	2
Bad	1

The response data was searched for the average value to determine the practicality of student worksheet. The average score was converted by the formula (Safenita et al., 2023):

$$\bar{x} = \frac{\sum \text{Total score}}{\text{Maksimum score}} \times 5$$

The average results of the assessment can be seen in Table 3 (Safenita et al., 2023).

Table 3. Practicality Criteria

Score Interval	Criteria
$\bar{x} > 4,2$	Very practical
$3,4 < \bar{x} \leq 4,2$	Practical
$2,6 < \bar{x} \leq 3,4$	Practical enough
$1,8 < \bar{x} \leq 2,6$	Less practical
$\bar{x} \leq 1,8$	Not practical

## Results and Discussion

### Result

The development of this research was carried out on a practicality test, while the validity stage had been carried out before. The practicality carried out aims to see the practicality and efficiency of worksheets for students to use in mathematics learning. The following describes the results of the define, design, and develop stages.

#### 1. Define stage

At this stage, data was obtained that almost all students had difficulties in understanding and accessing math lessons in distance learning. Some learning difficulties found are that students find it difficult to understand the linear program material taught. The utilization of teaching materials such as package books and student worksheets has been used, but the presentation of the student worksheets given do not contain learning by revealing the basic concepts of linear programs, such as the concept of two-variable linear inequality and presenting graphs of contextual problems of two-variable linear inequality systems.

#### 2. Design stage

At this stage, the product to be developed is designed according to learning needs. The development of student worksheets with linear program material contains basic competencies, indicators and learning objectives that have been adjusted. The format compiled on this student worksheets consist of a cover, identity of student worksheets, preface, table of contents, instructions for using student worksheets, components of the Treffinger model, content standards, concept maps, presentation of material, assignments, and bibliography.

#### 3. Develop stage

At this stage, the designed product is tested for validity and practicality. Research at the previous validation stage has been carried out presented in Figure 1 below.

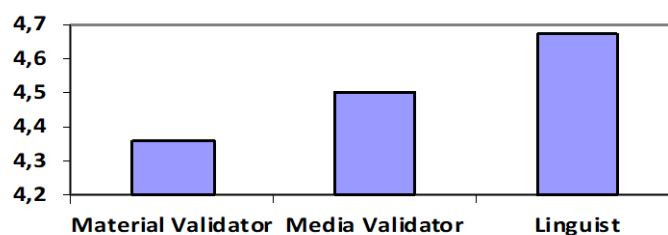


Figure 1. Worksheet Validity Test Results by Validators

Based on Figure 1, menunjukkan hasil uji validitas dari ahli materi sebesar 4,36, oleh ahli media sebesar 4,5, dan oleh ahli bahasa sebesar 4,67. The average results of the LKPD validity test from the three experts are 4.51 which is categorized as very valid according to the criteria in Table 3, which it can be used with a little revision. Suggestions from validators regarding the worksheets are: improvements to sentence composition, providing sufficient space to answer questions, showing steps to determine the area of completion in graphs, and improving the writing prepositions, punctuation and question instructions. The following are the final results of the student worksheets based on the Treffinger model in Figure 2 and Figure 3.

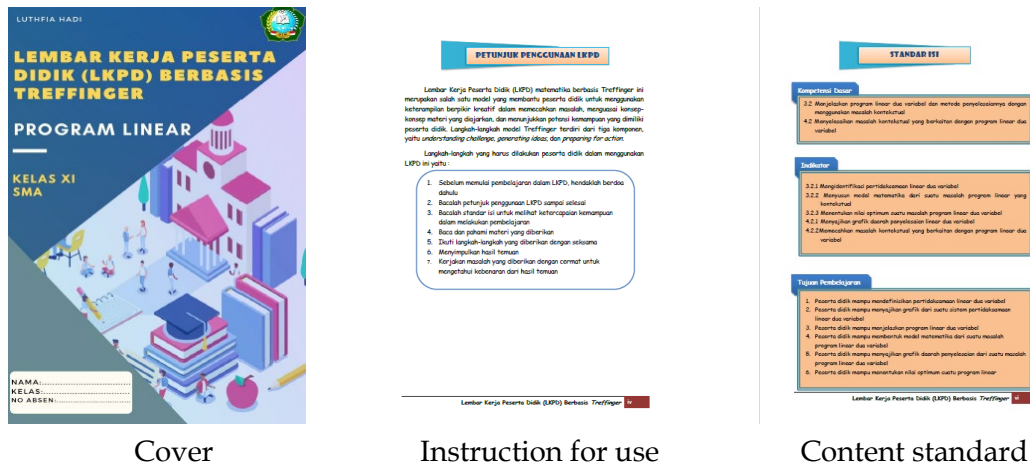
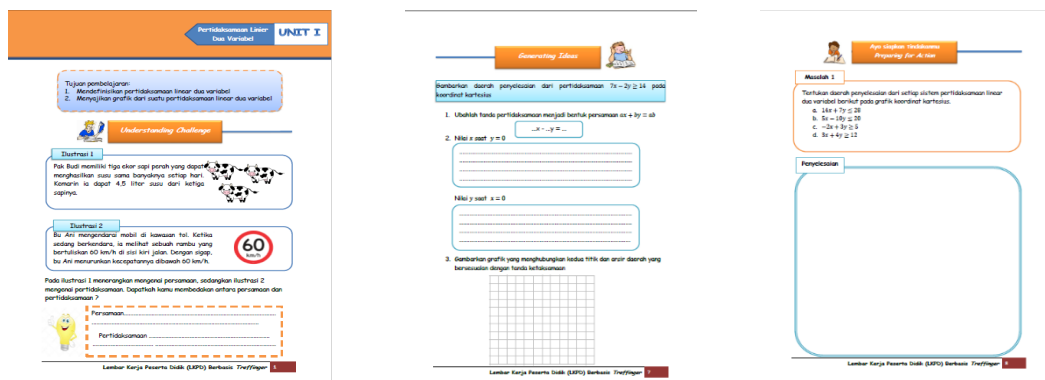


Figure 2. Basic components on student worksheets

Figure 2 shows the basic components of the student worksheets based on the Treffinger model, namely in the form of a cover, instructions for using student worksheets, and content standards containing basic competencies, indicators, and learning objectives. After that, the next page is the student worksheets material shown in Figure 3.



**Material**  
(The Treffinger stages of understanding challenges, contains contextual problems and material discussion)

**Questions**  
(The Treffinger stages of generating ideas, containing the opportunity to express their ideas on a problem)

**Assignments**  
(The Treffinger stages of preparing for action, contain tasks as evaluation material)

Figure 3. The Treffinger components on student worksheets

The components of the Treffinger model in Figure 3 consist of three parts, namely understanding challenge, generating ideas, and preparing for action in each material unit. After the worksheets is declared valid, it can be given to teachers and students to know the practicality. The results of the worksheets practicality test analysis by teachers can be seen in Table 4 as follow.

Table 4. Worksheet Questionnaire Results by Teacher

No	Assessment Aspect	Average
1	Contents of material	4
2	Attractiveness of appearance	4
3	Ease of use	4
4	Use of model	4
<b>Total Average</b>		<b>4</b>
<b>Criteria</b>		<b>Practical</b>

Table 4 shows that the results of the worksheet practicality test by teachers obtained an overall average of 4 with practical criteria. The suggestion from the teacher regarding student worksheet is that worksheet should have more exercise/question starting from easy, medium, and difficult levels. While the results of the practicality test analysis by students can be seen in Table 5 below.

Table 5. Worksheet Questionnaire Results by Students

No	Assessment Indicator	Average
1	Contents of material	3,8
2	Attractiveness of appearance	3,6
3	Ease of use	3,6
4	Use of model	3,5
<b>Total Average</b>		<b>3,6</b>
<b>Criteria</b>		<b>Practical</b>

In Table 5, the average practicality of worksheet by students is 3.6 categorized as practical. From the results of interviews conducted by researchers on students, as many as 75% of students liked worksheet in the presentation of material and 72% of students liked the attractiveness of appearance. They are able to understand the contents even though it is not optimal due to limited learning time set and school regulations not to be allowed to create study groups. So there are parts of the Treffinger model steps that do not work effectively. The results of worksheet practicality by teachers and students can be seen in Figure 2 as follow.

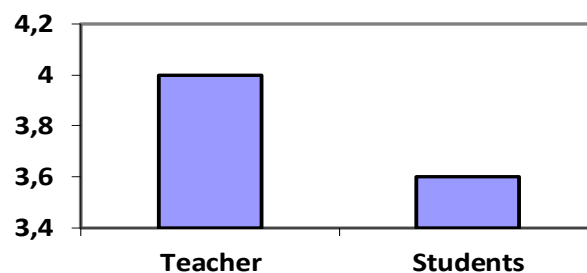


Figure 4. Worksheet Practicality Test Results by Teacher and Students



Based on Figure 4, it is explained that the practicality of student worksheets based on Treffinger model by mathematics teachers is obtained a value of 4 with a practical category. While by students, a value of 3.6 was obtained in the practical category. This shows that the student worksheets based on Treffinger model is practical for use in learning linear program.

## **Discussion**

Practicality can be measured if the worksheet has reached the validity requirements. The validity of an worksheets shows that it can be carried out in field trials (Safenita et al., 2023). Based on the validity test, the developed worksheets based on Treffinger model obtained results from validators are very valid categories. This is accordance to Effendi's research, that assessments from validators with very valid validation results can be used in learning (Effendi et al., 2021). The worksheets that has been valid, can be given or used by students in learning.

The validity of worksheet can be stated that the concepts of material in linear programs can be used in mathematical learning, and the use of the Treffinger model has been suitably applied to linear program materials. A linear program is one of the complex materials and integrated with the previous material, such as equations and inequalities of lines that have the final result in the form of concrete models, which are applied in real life. So, to introduce it to students, systematic and easy-to-understand steps are needed. One suitable use of models for this material is the Treffinger model.

The application of the Treffinger Model in linear program material presents a three-phase learning approach, namely Understanding challenge, Generating idea, and Prepare for action. The Understanding Challenge phase, students are invited to understand the concrete problems along with step by step to solve them. By introducing concrete problems, students will understand the use of the material learned. The next phase is Generating ideas, providing some related problems so that students are given time and opportunity to express their ideas. Providing good material is to involve students actively expressing their ideas on the material. The last phase is Prepare for action, which is the provision of individual tasks as evaluation material from the previous phase. With evaluation, it can be known the success of the learning process and improvement in the implementation of learning (Sudjana, 2017).

The results of the worksheet practicality test by teachers and students in each aspect tested were obtained in the practical category. The determination of the level of practicality of worksheet is seen from four aspects, namely aspects of material presentation, ease of use, attractiveness of appearance, and use of the Treffinger model. From these four aspects, the aspect of content of material has the highest average score, this is because students have never seen worksheets presented with the Treffinger model. Also 75% of students agreed that the Treffinger model applied was more attractive than the worksheets they used before. Azahar, et al (Azahar et al., 2023) in their research said that the Treffinger model applied to mathematics modules is very practical to use. Students are more active and able to think more creatively (Azahar et al., 2023). Rangkuti (2022) also stated that students' concept understanding using the Treffinger model student worksheets increased by 80% of the total number of students.

The practice of student worksheet provides results that it has a level of efficiency in its application to learning activities. This is also appropriate in Handayani's research (2020), that students feel happy in learning using the Treffinger model (Handayani, 2020). In addition to feeling happy and interested in solving mathematical problems, students' mathematical abilities also increase such as concept understanding ability (Rangkuti, 2022) and creative thinking ability (Azahar et al., 2023; Rangkuti, 2022; Handayani, 2020). Based on the results of practicality tests by teachers and students, it can be concluded that student worksheet with the Treffinger model is practically used in mathematic learning especially on linear program



material. Further research can be used at the stage of testing the effectiveness of the Treffinger model student worksheets on linear program and the application of the Treffinger model-based student worksheets on the mathematical abilities of students.

## Conclusion

Based on the results of the study, it can be concluded that the practicality of Treffinger model-based student worksheet reached the practical criteria, so that it can be applied in learning activities on linear program. The determination of the level of practicality of worksheet is seen from four aspects, the content of material aspect has the highest average score, this is because students have never seen worksheets of linear program presented with the Treffinger model. Recommendation for further research are could be to develop the student worksheets based on Treffinger model to the effectiveness test stage, to develop learning media that support Treffinger learning, and to analyze the extent to which Treffinger model affect students' mathematics ability and mathematics learning activities.

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