

# Analyzing Student Difficulties in Solving HOTS-Based Story Problems

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## Abstrak

Penelitian ini bertujuan untuk mengetahui kesulitan peserta didik dalam menyelesaikan soal cerita berbasis High Order Thinking Skill pada materi program linear. Subjek penelitian ini adalah peserta didik kelas XI MIPA 2 SMAN 2 Majene semester genap tahun ajaran 2020/2021 yang berjumlah 19 peserta didik dan dipilih 4 peserta didik dengan menggunakan teknik purposive sampling. Instrumen tes dan wawancara untuk melengkapi dan memperkuat informasi yang diperoleh. Penelitian ini menemukan 4 (empat) jenis kesulitan, yaitu: (1) Kesulitan dalam mempelajari konsep, memecahkan masalah verbal dan menerapkan prinsip pada level menganalisis, mengevaluasi dan mencipta; (2) Kurang mempelajari konsep pada level menganalisis, mengevaluasi dan mencipta tetapi masih kesulitan dalam memecahkan masalah verbal dan menerapkan prinsip pada level menganalisis, mengevaluasi dan mencipta; (3) Kurang mempelajari konsep, memecahkan masalah verbal dan menerapkan prinsip pada level menganalisis, mengevaluasi dan mencipta; (4) Mampu mempelajari konsep, memecahkan masalah verbal dan menerapkan prinsip pada level menganalisis, mengevaluasi dan mencipta.

Kata Kunci: Analisis Kesulitan; HOTS; Program Linear

## Abstract

This study aims to find out the difficulties of students in solving story problems based on High Order Thinking Skill in linear program materials. The subjects of this study are students in grade XI MIPA 2 SMAN 2 Majene even semester of the 2020/2021 school year which amounted to 19 students and 4 students were selected using purposive sampling techniques. Test and interview instruments to complement and reinforce the information obtained. The research found 4 (four) types of difficulties, namely: (1) Difficulties in learning concepts, solving verbal problems and applying principles at the level of analyzing, evaluating and creating; (2) Lack of learning concepts at the level of analyzing, evaluating and creating but still having difficulty in solving verbal problems and applying principles at the level of analyzing, evaluating and creating; (3) Lack of learning concepts, solving verbal problems and applying principles at the level of analyzing, evaluating and creating; (4) Able to learn concepts, solve verbal problems and apply principles at the level of analyzing, evaluating and creating.

Keywords: Difficulty analysis; HOTS; Linear programs

## I. INTRODUCTION

High Order Thinking Skill (HOTS) is a skill that is increasingly emphasized in 21st century learning (Susanti et al., 2023; Vrasetya & Nasution, 2024). In the context of mathematics learning, HOTS includes not only the ability to understand and memorize concepts, but also the ability to analyze, evaluate, and create solutions to complex problems (Ningsih et al., 2023). A person with a high level of thinking ability must be able to analyze, connect, decipher and interpret problems to obtain new solutions or ideas (Saraswati & Agustika, 2020; Murwanto, Qohar, & Sa'dijah, 2022).

The results of the 2018 PISA study released by the OECD, the average score of mathematics reached 379 with an average score of 487 OECD (Ministry of Education and Culture, 2019; Masfufah & Afriansyah, 2021). However, research reveals (Anggraini et al., 2019) that common difficulties in solving story problems occur in drawing conclusions, which are part of the dimension of evaluation (C5) or even creation (C6). This indicates that even though students can analyze, they are not yet fully able to develop new assessments or solutions independently.

The concept of high order thinking skills is based on several opinions, as can be seen in the Table 1.

Table 1.  
Basic Concepts of High Order Thinking Skill

Original Bloom Cognitive Taxonomy (1956)	Bloom's Taxonomy: Revised by Anderson & Krathwohl (2001)	Information
Knowledge	Remember	Lower
Comprehension	Understand	Order
Application	Apply	

Original Bloom Cognitive Taxonomy (1956)	Bloom's Taxonomy: Revised by Anderson & Krathwohl (2001)	Information
		Thinking Skill
Analysis	Analyze	Higher
Synthesis	Evaluate	Order
Evaluation	Create	Thinking Skill

(Source: Krathwohl, 2002)

This study aims to describe the difficulties experienced by students insolving HOTS story problems. Thus, the results of this research are expected to make a real contribution to the development of more effective learning strategies, as well as become a reference for teachers in designing more inclusive and meaningful HOTS-based questions and learning.

## II. METHOD

The type of research conducted is qualitative descriptive research. The purpose of this descriptive research is to make a systematic, factual and accurate description, description, or painting of the facts, properties and relationships between the phenomena under investigation. The research design used is a case study. With the aim of exploring specific and contextual issues in depth in the form of in-depth interviews and tests as data collection techniques.

The HOTS story questions were validated through content validation by two mathematics education experts using an assessment sheet based on indicators C4–C6 of the Revised Bloom Taxonomy. The focus of the case study research only

focuses on the issue of students' difficulties in solving HOTS-based story problems.

The difficulty indicator used is difficulty according to Cooney in which is categorized into 3 types, namely: a) difficulty in learning concepts (difficulty in learning concepts in one material), b) difficulty in applying principles (difficulty in applying concepts which means difficulty in relating concepts between materials, c) difficulty in solving verbal problems (difficulties in solving problems related to verbal problems or story problems) Abdurrahman (2012). Table 2 shows the indicators of difficulty in solving problems according Krathwohl (1956) to Cooney, who is the author of the adaptation of Abdurrahman.

Table 2.  
Indicators of Difficulty in Solving Problems

No.	Indicators	Translation
1	Difficulty learning concepts	Students find it difficult to learn mathematical concepts in solving problems
2	Difficulty in resolving verbal problems	Students have difficulty in solving verbal questions or story problems
3	Difficulties in applying principles	Students find it difficult to apply the principles they have obtained and difficult to apply them in solving problems

This research was carried out in the even semester of 2020/2021 at SMA Negeri 2 Majene. The subjects of the study were 19 students in grade XI MIPA 2. Meanwhile, the object of the research is the difficulty of students in solving HOTS- based story problems in linear program materials. The selected research subjects were 4 people with purposive sampling techniques.

The data analysis technique carried out is the flow model proposed by Miles and

Huberman, which includes data reduction activities, data presentation, conclusion drawing or verification (Sugiyono, 2016). Data reduction in this study was carried out by grouping and simplifying the results of student work on HOTS-based description questions. The data that has been reduced is then presented in the form of a narrative description to facilitate the drawing of conclusions. Conclusions and verification are carried out based on the interpretation of the narrative description that has been presented.

### III. RESULT AND DISCUSSION

Based on the results of the test, students obtained 4 types of student difficulties in solving HOTS story questions.

Table 3.  
Types of Students' Difficulties in Solving HOTS Story Problems

No.	Difficulty Type	Number of Subject
1	Students have difficulty learning concepts, solving verbal problems, and applying principles	3
2	Studentslack in learning concepts, difficulty in solving verbal problems and applying principles	12
3	Students are less likely to learn concepts, solve verbal problems and apply principles	2
4	Students are able to learn concepts, solve verbal problems and apply principles	2
	Sum	19

Table 4.  
Coding on Difficulty Indicators in Solving Problems

No.	Difficulty Indicator	Code
1	Difficulty in learning concept	K <sub>1</sub>
2	Difficulty in resolving verbal problems	K <sub>2</sub>
3	Difficulties in applying principles	K <sub>3</sub>

Furthermore, as many as one subject was selected by purposive sampling of each type of students' difficulties in solving HOTS-based story problems on the subject of the linear program as presented in the Table 5.

Table 5.  
Coding on Selected Subjects

No.	Code
1	KS
2	KKS
3	KM
4	M

Information:

- S : Subject
- KS : First type difficulty
- KKS : Second type difficulty
- KM : Third type difficulty
- M : Fourth type difficulty

The following will be presented four excerpts from the results of students' answers in working on HOTS story questions at the cognitive level of analyzing, evaluating and creating based on the type of student difficulty:

**A. Subject of KS**

The subject of KS is the subject of the first type of difficulty, namely students' difficulties in learning concepts, difficulties in solving verbal problems and difficulties in applying principles.

**1. KS subject in question number 2 (levels C4 and C5)**

Question number 2 is a question that includes analyzing (C4) and evaluating (C5) indicators. At the C4 level, it is analyzing information on the problem which is then made a mathematical model. Next, the C5 level is to make a hypothesis and conduct tests. The difficulties experienced by the KS subject in question number 2 are described as follows.

**a. Subject  $KS_{K_1}$**

In this difficulty, students have difficulty in understanding the purpose of the question so that they are unable to identify the information in the question correctly.

The subject  $KS_{K_1}$  in solving question item number 2, difficulties in understanding the concept in the form of writing down what is known and asked questions. According to research, it is stated that difficulty learning concepts in the form of students have difficulty understanding the meaning of the questions, especially in identifying information that is known and asked Harleni (2021). Based on this, it can be said that students have difficulty in learning concepts.

**b. Subject  $KS_{K_2}$**

In this difficulty, students have difficulty in changing the language of the question to the language of mathematics so that a mathematical model is formed.

The subject  $KS_{K_2}$  in solving question item number 2 is not able to identify the information in the problem so that it is difficult to take the next step such as changing the language of the question to a mathematical language which is then made a mathematical model.

According to the research, it is stated that verbal difficulties in the form of mistakes are still wrong in changing the story problem model into a mathematical model Azhimuh et al (2021). Based on this, it can be said that students have difficulty in solving verbal problems.

**c. Subject  $KS_{K_3}$**

In this difficulty, students have difficulty in choosing and using appropriate formulas and strategies. The subject  $KS_{K_3}$  in solving

question item number 2 students have difficulty in carrying out the calculation process (formula) and the strategy carried out to obtain what is asked of the question.

The subject  $KS_{K_3}$  also did not know the formula (elimination and substitution) and the strategy used in obtaining what was asked. In accordance with the research Khasanah (2015), students cannot use formulas correctly or there is a mistake in substituting what is known in the formula, resulting in students not being able to solve a problem correctly. Based on this, it can be said that students have difficulty in applying the principles.

## 2. KS subject in question number 1 (C6 level)

Question number 1 is a question that includes the indicator of creation, namely the emergence of a new model. The difficulties experienced by the KS subject in question number 1 are described as follows.

### a. Subject $KS_{K_1}$

In this difficulty, students have difficulty in understanding the purpose of the question so that they are unable to identify the information in the question correctly.

The subject  $KS_{K_1}$  in solving question item number 1 has difficulty in understanding the meaning of the problem where students who do not write down what is known completely even though they only write the form  $x + ay \leq 120$ . Research Harleni (2021) states that students have difficulty in understanding the problem by not writing down what they know and are asked about the problem. Based on this, it can be said that students have difficulty in learning concepts.

### b. Subject $KS_{K_2}$

In this difficulty, students have difficulty in changing the language of the question to the language of mathematics so that a mathematical model is formed.

The subject  $KS_{K_2}$  in solving question item number 1, students who do not write down what they know and ask make it difficult for students to determine what steps to take next. As a result, students have difficulty converting problem sentences into mathematical models and determining the right completion steps (Pratiwi, 2019). Based on this, it can be said that students have difficulty in solving verbal problems.

### c. Subject $KS_{K_3}$

In this difficulty, students have difficulty in choosing and using appropriate formulas and strategies.

The subject  $KS_{K_3}$  in solving question item number 1, students do not know the calculation process (formula) and the strategy used to obtain what is asked because students are confused and do not know how to solve it.

The subject  $KS_{K_3}$  does not do any work at all to solve the item of question number 1 because of confusion in completing or starting the step in solving problem number 1. The inability to devise strategies such as elimination and substitution due to a weak understanding of the basics. Purwanti et al (2020) based on this, it can be said that students have difficulty applying the principles.

## B. Subject of KKS

The subject of KKS is the subject of the second type of difficulty, namely students lack in learning concepts, difficulties in

solving verbal problems and difficulties in applying principles.

**1. KKS subject in question number 2 (C4 and C5 levels)**

Question number 2 is a question that includes analyzing (C4) and evaluating (C5) indicators. At the C4 level, it is analyzing information on the problem which is then made a mathematical model. Next, the C5 level is to make a hypothesis and conduct tests. The difficulties experienced by the KKS subjects in question number 2 are described as follows.

**a. Subject  $KKS_{K_1}$**

In this difficulty, students have difficulty in understanding the purpose of the question so that they are unable to identify the information in the question correctly.

The subject  $KKS_{K_1}$  completes question item number 2, knowing what is known and asked in the question even though he only writes down some of the known information. Students with moderate abilities can understand the problem and plan a solution even if they don't write down all the information known (Amaliah et al., 2021).

Based on this, it can be said that students are still lacking in learning concepts.

**b. Subject  $KKS_{K_2}$**

In this difficulty, students have difficulty in changing the language of the question to the language of mathematics so that a mathematical model is formed.

The subject  $KKS_{K_2}$  in solving question item number 2, does not know the steps that must be taken in solving the linear program problems before going to the calculation process.

Students who have difficulty solving verbal problems are students who are not right in translating into mathematical models (Dewi, 2020). Based on this, it can be said that students have difficulty in solving verbal problems.

**c. Subject  $KKS_{K_3}$**

In this difficulty, students have difficulty in choosing and using appropriate formulas and strategies.

The subject  $KKS_{K_3}$  in solving question item number 2, did not know the strategy carried out in seeking profits, it was seen that the students were careless in answering, namely the trader's capital divided by the price of each product so that product A was obtained Rp 520,000 and for product B it was 220,000. Furthermore, to obtain the trader's profit, namely with the purchase price of each product multiplied by the capacity of the warehouse, obtained for product A, which is 1,000,000 and product B, which is 20,000,000.

Students do not understand basic concepts so that it has an impact on the completion strategy. Based on this, it can be said that students have difficulty in applying the principles (Pratiwi, 2019).

**2. The subject of the KKS in question number 1 (level C6)**

Question number 1 is a question that includes the indicator of creation, namely the emergence of a new model. The difficulties experienced by the KKS subjects in question number 1 are described as follows.

**a. Subject  $KKS_{K_1}$**

In this difficulty, students have difficulty in understanding the purpose of the

question so that they are unable to identify the information in the question correctly. The subject in solving question item number 1, knows what is known and asked in the question even though it is only written.  $KKS_{K_1}$   $600m^2$ ,  $5m^2$  dan  $20m^2$ .

Students understand the meaning of the question so that they can identify information even though they have not written it down completely. Based on this, it can be said that students are lacking in learning concepts (Amaliah et al., 2021).

#### b. Subject $KKS_{K_2}$

In this difficulty, students have difficulty in changing the language of the question to the language of mathematics so that a mathematical model is formed.

The subject  $KKS_{K_2}$  in solving problem number 1, the student only rewrites the information  $x + a \leq 120$ ; and  $\leq 300$ ;  $x \geq 0$ ; and  $\geq 0$ .

Students are not yet able to change the language of the question to the language of mathematics and make mathematical models. Based on this, it can be said that students have difficulty in solving verbal problems (Dewi, 2020).

#### c. Subject $KKS_{K_3}$

In this difficulty, students have difficulty in choosing and using appropriate formulas and strategies.

The subject  $KKS_{K_3}$  in solving problem number 1, does not know what next steps must be taken in solving the problem and it is difficult to determine the strategy to be carried out in finding a value.

Students who are not able to carry out strategies to formulate new procedures will have an impact on getting results that are in accordance with the questions in the

question Based on this, it can be said that students have difficulty in applying the principles (Pratiwi, 2019).

### C. Subject of KM

KM subjects are subjects of the third type of difficulty, namely students lack in learning concepts, solving verbal problems and applying principles.

#### 1. KM subject in question number 2 (level C4 and C5)

Question number 2 is a question that includes analyzing (C4) and evaluating (C5) indicators. At the C4 level, it is analyzing information on the problem which is then made a mathematical model. Next, the C5 level is to make a hypothesis and conduct tests. The difficulties experienced by the KM subject in question number 2 are described as follows.

##### a. Subject $KM_{K_1}$

In this difficulty, students have difficulty in understanding the purpose of the question so that they are unable to identify the information in the question correctly.

The subject  $KM_{K_1}$  in solving question item number 2, understands the purpose of the question so that they can identify information in the form of what is known and asked in the question but on the answer sheet the student does not write it. This is in line with research Putri & Fuadiah (2019) stating that there is an internal understanding that is not documented on the answer sheet.

Based on this, it can be said that students are still lacking in learning concepts.

##### b. Subject $KM_{K_2}$

In this difficulty, students have difficulty in changing the language of the question to

the language of mathematics so that a mathematical model is formed.

The subject  $KM_{K_2}$  in solving question item number 2 is still lacking in changing the question language to the language of mathematics.

Students do not yet fully understand how to change the language of the question to the language of mathematics; They are able to use  $\leq$  signs correctly, but are still confused in guessing X and Y and do not realize that the shapes they create are mathematical models.

Students can apply mathematical symbols such as  $\leq$ , they still have difficulty in the stage of understanding and transforming the problem into the right form of mathematical model. Based on this, it can be said that students are still lacking in solving verbal problems (Kholifah et al., 2021).

**c. Subject  $KM_{K_3}$**

In this difficulty, students have difficulty in choosing and using appropriate formulas and strategies.

The subject  $KM_{K_3}$  in solving question item number 2 is able to simplify in the form of  $2000A + 4000B \leq 1,600,000$  so that the value is simpler which then eliminates and substitutes with  $A + B \leq 500$  but to gain advantage the student does not understand how.

Subjects  $KM_{K_3}$  try to use formulas (elimination and substitution) and strategies to obtain the questions asked. However, students are not yet able to determine the next idea or step so the calculation process is not completed. Based on this, it can be said that students are still lacking in applying principles (Munfarikhatin et al., 2022).

**2. KM subject in question number 1 (level C6)**

Question number 1 is a question that includes the indicator of creation, namely the emergence of a new model. The difficulties experienced by the KM subject in question number 1 are described as follows.

**a. Subject  $KM_{K_1}$**

In this difficulty, students have difficulty in understanding the purpose of the question so that they are unable to identify the information in the question correctly.

The subject  $KM_{K_1}$  in solving question item number 1 understands the purpose of the question so that he can identify the information that is known and asked about the question but does not write it down on the answer sheet. This is in line with research Putri & Fuadiah (2019) stating that there is an internal understanding that is not documented on the answer sheet.

Based on this, it can be said that students are still lacking in learning concepts.

**b. Subject  $KM_{K_2}$**

In this difficulty, students have difficulty in changing the language of the question to the language of mathematics so that a mathematical model is formed.

The subject  $KM_{K_2}$  in solving question item number 1 of students who are less able to change the language of the problem to the language of mathematics can be seen from the students who are still wrong if they say x and y, but the students know that the signs of inequality  $\leq$  in the sentences "as wide as the ground" and "cannot contain more than" and also the students do not know the mathematical model.

Students still experience confusion in changing the language of the question into

a language and mathematical model; Although the results of the students' work are almost perfect, they do not fully understand the meaning of what is written. Based on this, it can be said that students are still lacking in solving verbal problems (Kholifah et al., 2021).

#### c. Subject $KM_{K_3}$

In this difficulty, students have difficulty in choosing and using appropriate formulas and strategies.

The subject  $KM_{K_3}$  in solving question item number 1 does not know the strategy in obtaining an a grade and the student only goes to the stage of simplification process so that the score becomes simple without knowing that when simplifying it is directed to the form  $x + ay \leq 120$ .

Students have not formulated a new procedure from the strategy that has been carried out (Pratiwi, 2019). Based on this, it can be said that students are still lacking in applying principles.

#### D. Subject M

Subject M is a subject of the fourth type of difficulty, namely students are able to learn concepts, solve verbal problems and apply principles.

##### 1. Subject M in question number 2 (levels C4 and C5)

Question number 2 is a question that includes analyzing (C4) and evaluating (C5) indicators. At the C4 level, it is analyzing information on the problem which is then made a mathematical model. Next, the C5 level is to make a hypothesis and conduct tests. The difficulties experienced by subject M in question number 2 are described as follows.

##### a. Subject $M_{K_1}$

In this difficulty, students do not have difficulty in understanding the purpose of the question so that they are not able to identify the information in the question correctly.

The subject  $M_{K_1}$  in solving question item number 2 already knows what is known and asked in the question even though on the answer sheet the student does not write down what is known and asked.

This is in line with research Putri & Fuadiah (2019) stating that there is an internal understanding that is not documented on the answer sheet. Based on this, it can be said that students are capable of learning concepts.

##### b. Subject $M_{K_2}$

In this difficulty, students do not have difficulty in changing the language of the question to the language of mathematics so that a mathematical model is formed.

The subject  $M_{K_2}$  in solving question item number 2 students are able to make an example of  $x$  and  $y$  and also the  $\leq$  sign used by the students from the sentences "the capital owned by traders is 1,600,000", "a warehouse that can accommodate a maximum of 500 units". While the  $x$  sign  $\geq 0$ ;  $y \geq 0$  it can be seen that many products A are purchased at a price above the value of 0, namely 2000 and 4000. Furthermore, students who are able to determine the next step after changing the language of the question to the language of mathematics are to make a mathematical model and the students show that the mathematical model is  $2000x + 4000y \leq 1,600,000$ ;  $x + y \leq 500$ ;  $x \geq 0$ ;  $y \geq 0$  and  $Z = 800x + 600y$ .

However, this is in contrast to findings Hidayat et al (2020) showing that low-achieving students have particular difficulties in transforming from real to mathematical contexts. Based on this hadi, it can be said that students are able to solve verbal problems.

**c. Subject  $M_{K_3}$**

In this difficulty, students do not have difficulty in choosing and using appropriate formulas and strategies.

The subject  $M_{K_3}$  in solving question item number 2, simplifies the inequality of  $2000x + 4000y \leq 1,600,000$  by dividing the two fields by 2000 so that  $x + 2y \leq 800$  is obtained to make it easier to determine the coordinate points. They also use elimination and substitution methods to determine the cut-off point, then create a chart as an initial strategy. The graph helps to select the coordinate points to be included in the  $800x + 600y$  profit function, so that a maximum profit of Rp400,000 is obtained at point (500.0)."

In modeling, understanding the real-world context is essential. The questions that arise during this process help clarify assumptions, filter out relevant information, and avoid misinterpretations. Based on this, it can be said that students are capable of applying principles (Fukushima, 2021).

**2. Subject M at level C6**

Question number 1 is a question that includes the indicator of creation, namely the emergence of a new model. The difficulties experienced by subject M in question number 1 are described as follows.

**a. Subject  $M_{K_1}$**

In this difficulty, students do not have difficulty in understanding the purpose of the question so that they are not able to identify the information in the question correctly.

The subject  $M_{K_1}$  in solving question item number 1, students understand the purpose of the question so that they can identify the information known and asked in the question (Putri & Fuadiah, 2019). Based on this, it can be said that students are capable of learning concepts.

**b. Subject  $M_{K_2}$**

In this difficulty, students do not have difficulty in changing the language of the question to the language of mathematics so that a mathematical model is formed.

The subject  $M_{K_2}$  in solving question item number 1 is able to change the language of the problem to mathematical language such as  $x$ ,  $y$ ,  $\leq$  and  $\geq$  signs. Students are able to understand the shapes they make ( $5x + 20y \leq 600$ ;  $x + y \leq 70$ ,  $x \geq 0$  and  $y \geq 0$ ) in the form of mathematical models.

However, this is in Hidayat et al (2020) contrast to findings showing that low-achieving students have particular difficulties in transforming from real to mathematical contexts. Based on this, it can be said that students are able to solve verbal problems.

**c. Subject  $M_{K_3}$**

In this difficulty, students do not have difficulty in choosing and using appropriate formulas and strategies. The subject  $M_{K_3}$  in solving question item number 1 of the strategy carried out by the students is appropriate as seen from the students who explained that after simplifying the

inequality by dividing the two sections with a value of 5, an equation similar to . The next step is to conclude that so that the value  $a = 4$ .  $5x + 20y \leq 600x + ay \leq 120x + 4y \leq 120x + 4y \leq 120 \equiv x + ay \leq 120$ .

In modeling, understanding the real-world context is essential. The questions that arise during this process help clarify assumptions, filter out relevant information, and avoid misinterpretations (Fukushima, 2021). Based on this, it can be said that students are capable of applying principles.

#### IV. CONCLUSION

The results of the study show that students' difficulties in solving HOTS-based story problems on the subject of linear programs can be classified into four types. The first to third types show obstacles in the aspects of understanding concepts, solving verbal problems, and applying mathematical principles, with consistent weaknesses at the level of high thinking such as analyzing, evaluating, and creating. Meanwhile, the fourth type describes students who have mastered all three aspects and are able to demonstrate good HOTS skills. These findings confirm the need for targeted learning interventions to strengthen conceptual understanding and higher-level thinking skills in linear programs.

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