



Posing Arithmetic Problems for Junior High School Students with Different Cognitive Styles

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ABSTRAK

Penelitian ini bertujuan untuk mendeskripsikan proses pengajuan masalah aritmetika siswa sekolah menengah pertama dengan gaya kognitif berbeda. Masalah yang diajukan akan dinilai berdasarkan empat proses pengajuan masalah yaitu *editing*, *selecting*, *comprehending* dan *translating*. Pengajuan masalah tipe bebas digunakan dalam penelitian ini. Penelitian ini merupakan penelitian deskriptif dengan pendekatan kualitatif. Pemilihan subjek dilakukan dengan memberikan TKM, GEFT dan BSRI. Pengumpulan data dilakukan melalui tugas tertulis dan wawancara berbasis pada tugas. Subyeknya adalah empat siswa SMP. Dua memiliki gaya kognitif *Field Dependent* (FD) dan dua yang lain *Field Independent* (FI) yang diukur dengan GEFT. Selanjutnya, data dianalisis berdasarkan empat proses pengajuan masalah. Hasil penelitian menunjukkan bahwa pengajuan masalah aritmetika siswa FI memenuhi keempat proses pengajuan masalah, dan pengajuan masalah aritmetika siswa FD memenuhi tiga proses pengajuan masalah. Masalah yang diajukan oleh kedua subjek secara umum adalah masalah yang pernah subjek temui atau subjek alami. Siswa FD dapat mengajukan masalah lebih banyak dari pada siswa FI.

ABSTRACT

This study aims to describe the process of posing arithmetic problems for junior high school students with different cognitive styles. The posed problems were assessed based on four processes of posing problems: editing, selecting, comprehending, and translating. Free-type problem posing was used in this study. This study is descriptive research with a qualitative approach. Subject selection was conducted by providing TKM, GEFT, and BSRI. Data collection was conducted through written task and task-based interviews. The subject was four junior high school students. Two has Field Dependent (FD) cognitive style, and the other is Field Independent (FI), measured by GEFT. Furthermore, the data were analyzed based on the four processes of posing problems. The results showed that posing arithmetic problems for FI students fulfilled all four processes of posing problems, and posing arithmetic problems for FD students fulfilled three processes for posing problems. In general, the problems raised by the two subjects were problems the subject had encountered or experienced. FD students can pose more problems than FI students.

Keywords:

Problem Posing

Arithmetic;

Cognitive Style;

Field Dependent;

Field Independent

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Introduction

An interesting learning approach in learning mathematics is the problem-posing approach. According to Siswono (2018), Thobroni (2000), Arian & Unal (2014), and Patac et al. (2022), problem-posing has a positive impact on students. In addition, NCTM (2000) states that problem-posing is highly recommended, especially in mathematics education. In addition, Georgiev & Nedyalkova (2011) stated that one of the supports for improving students' mathematical abilities is through problem-posing activities. Anim et al. (2019) also state that problem-posing can be applied effectively to students. Problem posing is the process of students formulating a new problem or problem based on the information provided. Stoyanova & Ellerton (in Baumanns & Rott, 2022:252) state problem posing as a "process by which, based on mathematical experience, students construct personal interpretations of concrete situations and formulate them as meaningful mathematical problems." The problem-posing process used in this study is as follows

Table 1
Problem Posing Taxonomy

Problem Posing Process	Indicator
<i>Editing</i>	Posing problems without any specific orders/provisions as to what the problem is being asked for (posing the problem based on the information provided)
<i>Selecting</i>	Posing problems according to the answer explicitly given (choosing the appropriate information)
<i>Comprehending</i>	Posing problems from given mathematical equations or calculations (understanding and associating information)
<i>Translating</i>	Posing problems or questions from graphs, charts or tables (translating information)

(Christou et al., 2005)

Each student's problem-posing process is different due to differences in cognitive styles. According to Brown et al. (2006) and Konzhevnikov (2007) (in Ulya & Retnoningsih, 2014:577), "cognitive style refers to someone's characteristic in responding, processing, storing, thinking, and using information to respond to a task or various types of environmental situations." Singer et al. (2017) stated that a person's cognitive style can stimulate creativity in asking questions. Witkin divides cognitive styles into Field-Dependent (FD) and Field-Independent (FI). In general, the difference in the characteristics of FD and FI students is how the environment influences students' perspectives on something.

Studies have shown differences in the problem-posing process regarding the FD and FI cognitive styles. Research by Nicolaou & Xistouri (2011) on the relationship between FD and FI cognitive styles with problem posing revealed that FI students were better at problem posing. Another research on creativity poses problems for FD and FI students in geometry by Azlina et al. (2018) revealed that FI students fulfilled all three components of creativity, and FD students only fulfilled two. Another study by (Nuraida et al. (2022), Novianti et al. (2020), and Rahman & Ahmar (2017) also shows differences in the problem-solving of FI and FD students. In this study, researchers are interested in discussing arithmetic material because it is the basic material in mathematics and is very closely related to everyday life. This study describes the problem-posing process of junior high school students with FD and FI cognitive styles on Arithmetic material.

Methods

This study uses a descriptive design with a qualitative approach. Before doing the research, several research instruments, such as worksheets for posing mathematical problems and interview guidelines, were determined and validated. Determination of the subject's cognitive style was carried out through the GEFT (Group Embedded Figures Test). The minimum score obtained by students is 0 and the maximum is 18. Students with a score of 0-9 are classified as students with the FD cognitive style. While students with a score of 9-18 are classified as students with the FI cognitive style. The selected subjects are those who have very low score and very high scores or are called extreme FI or extreme FD. The GEFT results determined four subjects with different cognitive styles, two extreme FD subject, and the other extreme FI subject. Besides GEFT results, the subject is also determined by considering that both have high mathematical abilities by giving TKM (Mathematics Ability Test). There are four TKM questions and each question has a maximum 25 scores. Based on the subject's TKM score, it is categorized as having high mathematical ability if it gets a score of 75-100. So that the results of the study were not influenced by gender and sex, the researchers provided a gender questionnaire which was carried out through the BSRI (Bem Sex Role Inventory) and obtained a masculine subject with the male sex. In addition, consideration of good communication skills for conducting interviews to obtain complete data about the process of submitting arithmetic questions.

Data was collected through written assignments about posing mathematical problems and task-based interviews. Each research finding is supported by two sources. Each finding is validated on the basis of two data from two different subjects. This study uses a semi-structured problem-posing model and a pre-solution type because students are asked to pose mathematical problems freely based on the information provided. The information provided in the math problem submission task sheet is four different pieces according to the problem-posing process. The information in the first math problem assignment consists of the food menu and the price. The information given in the second math problem submission task is in the form of a story. The information provided in the third math problem assignment task consists of mathematical equations. The information in the fourth math problem assignment consists of a table of daily allowances for five children.

Result and Discussion

The results of this study are an overview of the process of posing problems in the arithmetic problems of FD and FI students, which are described in detail as follows.

3.1. Field-Dependent Student

a. Editing

FD students posed five questions based on picture information of food menus and prices which directed the subject to answer with an editing process. Snippet of the question posed in Figure 1.

FD students stated that they could pose problem up to 30 problems based on the information provided. The first step in posing a problem is to look at the information. The idea of the questions came from the experience of FD students who had observed similar questions. The first question was without using mathematical operations because, according to the FD students, the first question had to be accessible in the hope that it would lead to the thinking of the students who did it that the following questions would be easy.

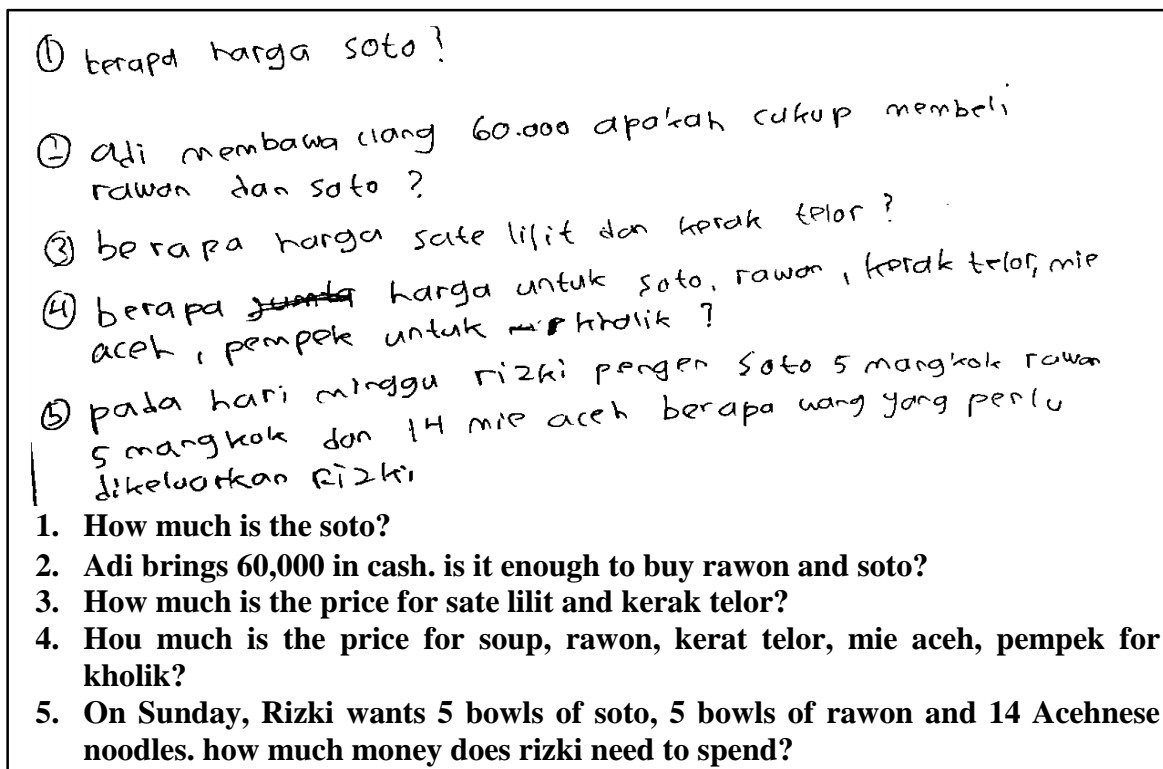


Figure 1.

The second question has operations or a higher level than the first one. The FD student determines the food menu based on his preferences and determines a nominal value of IDR 60,000 based on calculations to make money right. In the third question, the subject determines food based on his preferences. The questions were made to ask how much the two foods cost. The fourth question is that more and more food menus are presented in the questions because he wants the difficulty of the questions to increase. Determination of the food menu is selected randomly. The FD student's fifth question was more complex because he wanted the questions to have many calculations. From the third to fifth questions asked is the total price. FD students said they had yet to ask for the total price.

b. selecting

FD students posed three problems based on information from a story that directed the subject to answer using the selecting process—a Snippet of the question in Figure 2.

Initially, the FD students posed two problems based on the information provided. The first step in posing a problem is reading the command. The idea for the questions came from the FD students. The researcher asked why the first question was crossed out. Moreover, get the answer that it is wrong to make a question. The first and second problems submitted did not fulfill the selection process or choose the appropriate information because the questions asked did not use and choose from the information provided. FD student stated that he needed help understanding the instruction and only focused on the number 105 required by the order. The researcher asked FD students to pose problems following the instructions and obtained the third question. The idea for the questions came from the FD students. First, the FD students counted Mira, Joko, and Alin's pencils. Then try to add up. In order to comply with what was required in the command, a subtraction of 105 was made. Before writing the questions, FD students counted them first. The first and second questions submitted did not fulfill the selecting process; the third one fulfilled the selecting process.

① miftah punya 1 pensil lalu beli lagi 74 lalu diberi cakra 30 biji berapa pensil ~~miftah~~ miftah

② diketahui mira punya 35 pensil jika memiliki 35 pensil lebih banyak berapa pensil mereka berdua

③ mira memiliki 70 pensil jika memiliki 35 pensil er lebih banyak dan alin memiliki 35 pensil lebih sedikit lalu mereka mengumpulkan semua pensil mereka dan memberi 105 pensil ke teman-temannya berapa sisa pensil mereka bers

1. Miftah had 1 pencil then bought another 74 and was given to Cakra 30 pieces. How many Miftah pencils now?
2. Known that Mira has 35 pencils, Joko has 35 pencils more. how many pencils are they both?
3. Mira has 70 pencils, Joko has 35 pencils more than Mira and Alin has 35 pencils less than Mira. they collected all their pencils and gave 105 pencils to their friends. How many pencils do the three of them have left?

Figure 2.

c. Comprehending

FD students posed two problems based on information of mathematical equations that direct the subject to answer using the comprehending process—a Snippet of the question posed in Figure 3.

① uang harga 1 pensil 1000 uang miftah 2100 miftah ingin beli 1 pensil berapakah sisa uang miftah? lalu miftah diberi rizki 4.800 bersekarang berapa uang miftah

② miftah punya 2100 pensil lalu dicuri jawad 1000 lalu datanglah cakra memberi 4800 pensil berapa jumlah pensil miftah

1. the price of 1 pencil is 1000. Miftah's money is 2100. Miftah wants to buy 1 pencil. how much money is left? then Miftah was given rizki 4800. how much Miftah money now?
2. Miftah had 2100 pencils, then Jawad stole 1000 of them. Then Cakra came and gave 4800 pencils. how many Miftah pencils?

Figure 3.

The first step in posing a problem is reading the command. The idea for the questions came from the FD students. The subject determines the names on the questions because these names are close to him. In the first question, FD students made questions using existing mathematical equations, turning them into word problems. According to the FD student, there must be two questions because the equation contains brackets, so it must be calculated first. The second question is almost the same as the first one, but there is only one. The FD student stated that the 2,100 must have been operated first with the 1,000. The researcher asked why the problem contained the word "stealing," the FD student stated that he hated

his friend Jawad, so Jawad's character stole in that question. The two questions posed fulfill the process of comprehending.

d. Translating

FD students posed two questions based on information from a table which directed the subject to answer using the translating process—a Snippet of the question posed in Figure 4.

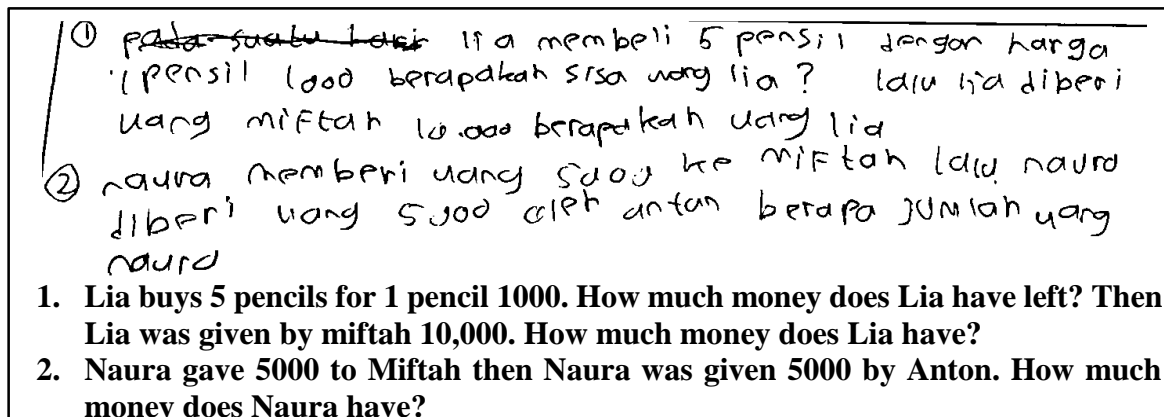


Figure 4.

The first step in posing a problem is reading the command. The idea of the questions came from the experience of FD students who had observed similar questions. The first question for FD students only uses the name Lia which is appropriate in the table. The FD student said Miftah was a new and good character, so he gave money to Lia. Miftah gave Lia because it was a pity that the money ran out after it was used to buy pencils. The FD student mentioned that there must be two questions to fulfill the command one addition and one subtraction. In the second question, there is only one question because, according to the FD students, there is one addition and one subtraction. The FD subject did not know why something could be separated and combined into one question. Miftah's name appears again as a new character. Both questions can only be done when a table is provided. The names Lia and Naura were randomly chosen by the FD subject in the table. The two questions posed fulfill the process of translating.

3.1. Field-Independent Student

a. Editing

FI students posed three questions based on picture information of food menus and prices which directed the subject to answer with an editing process—A snippet of the question posed in Figure 5.

FI students posed three questions based on the information provided. FI students stated that they could ask up to 20 questions based on the information provided. The first step in posing a problem is to look at the information. The idea of the questions came from the experience of FI students who had observed similar questions. The first question asks about fees to be paid. The selected food menu follows the food FI students like. When asked to make another question, FI students made a second question about change. 50,000 money and prices are calculated in advance so that there is a change. When asked how to buy three kinds of menus, FI students said they did not have enough money and questions could be asked, so they made a third question. The three questions show the editing process because FI students ask questions based on the information provided.

1. Dimas datang ke rumah makan tradisional dan melihat menu, Lalu Dimas memutuskan untuk membeli soto, rawon, dan lumpia untuk makanan penutup. Hitunglah biaya yang harus dibayar dimas!
 2. Dimas memiliki uang 50.000 kemudian membeli lumpia dan somay batagor. Hitunglah kembalian yang dimas terima!
 3. Jika uang dimas 50.000 dan dimas membelu somay batagor, kerak telur dan lumpia, berapa uang tambahan yang harus disiapkan dimas?
1. **Dimas came to a traditional restaurant and looked at the menu, then Dimas decided to buy soto, rawon and lumpia for dessert. Calculate the costs to be paid dimas!**
 2. **Dimas has 50,000 cash then buys spring rolls and somay batagor. Count the returns you received!**
 3. **If Dimas has 50,000 in cash and Dimas buys somay batagor, egg crust and spring rolls, how much additional money does Dimas have to prepare?**

Figure 5.

b. Selecting

FI students posed a question based on information from a story which directed the subject to answer by selecting—a Snippet of the question posed in Figure 6.

Jika Mira memiliki 70 pensil. Joko memiliki 35 pensil lebih banyak dari pada Mira dan Alin memiliki 35 pensil lebih sedikit dari pada Mira. Berapakah pensil yang dimiliki Joko?

if Mira has 70 pencils. Joko has 35 pencils more than Mira and Alin has 35 pencils less than Mira. How many pencils does Joko have?

Figure 6.

FI students make a question to finish quickly. The first step in posing the problem is counting the number of pencils for each child. Then make questions according to the existing story. All information in the story is used to make questions simple. However, in compiling questions, FI students chose the appropriate information to get results 105. The questions posed by FI students fulfilled the selecting process.

c. Comprehending

FI students submit a problem based on information from a mathematical equation which directs the subject to answer using the comprehending process—a Snippet of the question posed in Figure 7.

Cakra memiliki uang Rp2100, lalu Cakra memberikan Rp1000 kepada Dimas karena Dimas terlihat ingin membeli permen. Besoknya Dimas memberi uang berjumlah Rp 4800 kepada Cakra, sebab kemarin ia memberinya uang. Berapa jumlah uang Cakra sekarang?

Cakra has Rp 2,100 in cash, then Cakra gives Rp. 1,000 to Dimas because Dimas looks like wants to buy candy. The next day Dimas gave Rp 4,800 to Cakra, because yesterday he gave him money. How much money is Cakra now?

Figure 7.

The first step to posing a problem is reading the command. The idea for the question came from a problem FI students had encountered before. FI students like to make questions in story form because they are easy to understand. The subject determines the names on the questions because these names are close to him. According to FI students, mathematical equations are directly applied to word problems, making them easy to make. When asked to make another question, the FI students had no idea. So only ask one question. The questions submitted by FI students fulfill the comprehending process.

d. Translating

FI students submit a question based on information from a table that directs the subject to answer with a translation process—a snippet of the question posed in Figure 8.

Siti memiliki uang Rp 10.000. Lalu Anton memberikan Siti uang sebesar Rp 10.000 karena Anton merasa uang saku Siti terlihat sangat sedikit. Kemudian Siti menggunakan uang saku yang dimilikinya untuk membeli es krim sebesar Rp 5.000. Berapa uang yang dimiliki Siti sekarang?

Siti had money Rp 10,000. Then Anton gave Siti Rp 10, 000 because Anton felt that Siti's pocket money seemed very little. Then Siti used her pocket money Rp 5,000 to buy ice cream. How much money does Siti have now?

Figure 8.

The first step in posing a problem is reading the command. FI students use the names Anton and Siti because Anton has the most pocket money and Siti has the least. The question explained that Siti bought ice cream because, at that time, FI students were thinking about ice cream. FI students stated that Anton gave money to Siti because Anton knew that Siti had little pocket money and he wanted to buy ice cream. FI students used other information, namely the price of ice cream, because they felt they needed more information on pocket money in the table to make questions with one addition and one subtraction. The questions posed fulfill the process of translating.

Based on the presentation of the results and discussion, the initial step taken by the FD subject in submitting questions based on information on food price lists was to understand this information. The next step is finding ideas from the subject's personal experience. The next step is to check the questions he made so that they can be resolved. This step fulfills the indicators of the editing problem submission process, namely asking questions based on the information provided (Christou et al, 2005). The first step taken by the FD subject in asking questions based on information about the number of pencils each child has, is to understand the information. Then create questions according to the answers requested. However, the FD subject did not make questions based on the information provided but made questions based on his own ideas. When asked about the difference in information used in the problem, the FD subject stated that he did not fully understand the command. This is consistent with the characteristics of FD students who understand and approach things globally (Garger and Guild in Chu, 2008). Furthermore, the initial step taken by FD subjects in posing problems based on information about mathematical equations was to understand the information, then find ideas from the subject's personal experience. FD students are able to understand and relate information to story problems. This step is in accordance with the process of submitting comprehending problems (Christou et al, 2005).

The initial step taken by the FD subject in asking questions based on information about the amount of pocket money each child received was to understand the information, the next step was to find ideas for compiling questions. The idea is obtained from the personal experience of FD students. FD students can apply the amount of pocket money to the problem or can translate information on the amount of pocket money so that it is in accordance with the process of posing a translating problem (Christou et al, 2005). Another finding is that FD students tend to make a large number of questions. FD students also rank the question levels from the easiest. This is done so that students who are working on the problem feel interested in working on the next question because the beginning of the problem is very easy.

The first step taken by FI subjects in asking questions based on information on food price lists is to understand the information. The next step is to find ideas from reference questions that the subject has encountered before. The next step is to make questions according to the food price list information. This step is in accordance with the process of submitting editing problems (Christou et al, 2005). The initial step taken by the FI subject in asking questions based on information about the pencil that each child has is understanding the information, the next step is finding ideas, the next step is selecting the appropriate information to be used as a question. This step is in accordance with the process of submitting the selecting problem (Christou et al 2005). Furthermore, the first step taken by FI subjects in asking questions based on the mathematical equation information provided was to understand the information, then find ideas from a problem FI students had encountered before. FI students are able to understand and relate information to story problems. This step is in accordance with the process of submitting comprehending problems (Christou et al, 2005). The first step taken by subject FI in asking questions based on information about the amount of pocket money each child received was to understand the information, the next step was to find ideas for compiling questions. The idea is obtained from the personal experience of FI students. FI students can apply the information about the amount of pocket money to the problem by adding some additional information. FI subjects can translate information on the amount of pocket money so that it fulfills the indicators of submitting a translation problem (Christou et al, 2005). Another finding was that FI students tended to make fewer questions than FD students. FI students can fulfill all indicators of the problem-posing process because of the characteristics of FI students who understand and approach things analytically (Garger and Guild in Chu, 2008). Based on the presentation of these results, it was found that there were differences in the process of submitting problems by FI and FD students. This was supported by research by Rahman, A., & Ahmar, A. S. (2017). The difference is FI students are better at problem posing. This is supported by the research of Nicolaou and Xistouri (2011), Azlina et al (2018) and Nuraida et al (2022) that students with the FI cognitive style are better at posing problems.

Conclusion

From the previously presented description, the problems posed by FD students only fulfill three problem-posing processes: editing, comprehending, and translating. FD students cannot raise problems with the selecting process because they need help understanding the information thoroughly. After the interview process and understanding the information thoroughly, FD students can need help with the selecting process. The number of problems submitted by FD students consisted of 2-5 problems. The problems posed by FI students fulfilled four problem-posing processes: editing, selecting, comprehending, and translating. FI students can understand information thoroughly, so it is easy to ask questions. The number

of problems submitted by FI students consisted of 1 question each, and the editing process added two new problems during the interview process.

The similarity in the problem-posing process for FI and FD students is that it starts with reading the information. Determining the name in the question according to the closest friend, the idea of the question from personal experience, or previous questions. Both subjects were good at posing problems in the editing, comprehending, and translating processes. The difference in the process of filing problems for FI and FD students is the process of absorbing information. FI students absorb information better than FD students. FI students fulfilled the process of submitting selecting problems, while FD students still need to fulfill the process.

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