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Supporting Mathematics Teachers to Develop Jumping Task Using PISA Framework (JUMPISA)

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Abstract

The new revision of Curriculum 2013 stresses mathematics literacy tasks that force students to use their higher-order thinking skills (HOTs) and collaborative learning. In the Lesson study for the learning community, teachers deal with two kinds of problems: easy task or sharing and jumping task. This paper aims to report the process of training or professional development of mathematics teachers in Palembang in developing tasks, both sharing and jumping, using the PISA framework. This research used the development research method. Three main activities during the training are: Introducing what and why PISA items from 2000 – 2018; Developing PISA-items for jumping task; and The formative evaluation to measure teachers' knowledge after training. Results show that mathematics teachers who follow the training can produce their items, share, and jump, using the PISA framework. To conclude, the task design training program using examples of PISA like can support teachers in developing their task, both sharing and jumping.

Keywords: HOTs, Jumping Task, PISA, Use of Context, Mathematics literacy

Abstrak

Kurikulum 2013 edisi revisi menekankan pada penggunaan soal yang menuntut kemampuan berfikir tingkat tinggi (HOTs) dalam pembelajaran yang kolaboratif. Guru bekerjasama menggunakan sistem Lesson Study untuk membuat persiapan mengajar dan soal-soal matematika, soal-soal mudah maupun soal sulit. Tujuan artikel ini adalah untuk melaporkan proses pengembangan professionalisme guru matematika di Palembang dalam membuat soal-soal baik soal mudah maupun soal sulit menggunakan framework PISA (JUMPISA). Metode yang digunakan dalam kegiatan ini adalah riset pengembangan. Rangkaian kegiatan meliputi (1) Pencerahan apa dan mengapa soal-soal PISA dari tahun 2000 – 2015; (2) Pengembangan soal tipe PISA untuk *jumping task*; dan (3) Pemberian evaluasi formatif untuk mengukur pengetahuan para guru setelah diberikan pelatihan. Hasil dari pelatihan ini, guru mampu membuat soal mulai dari sharing task atau mudah dan soal yang sulit atau disebut jumpisa. Kesimpulan, dengan pelatihan yang menggunakan contoh-contoh soal dan kesempatan untuk membuat sendiri soal, guru mampu mengembangkan soal tipe pisa baik tingkat kesulitan mudah (sharing task) maupun sulit (jumping task).

Kata kunci: HOTs, Jumping Task, PISA, Pengunaan Konteks, Literasi Matematika,

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INTRODUCTION

As the benchmark that contributes to the valuable input for evaluating and improving the quality of human resources to compete with other countries, *Programme International Student Assessment* (PISA) has given many changes in the Indonesian mathematics curriculum (MOEC, 2016). A shocking result of PISA reports (OECD, 2016; 2019) revealed, Indonesia fared poorly in mathematics performance, which gives Indonesian students a score of 379, a 7-point decrease from the 2015 count, and puts significantly far below the OECD average of 489.

Some factors influencing the instability of students' performance, such as lack of abilities to solve non-routine or higher-order thinking skill (HOTs) problem (Yansen, Putri, Zulkardi, & Fatimah,

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2019; Jurnaidi & Zulkardi, 2013; Kohar, 2014), lack of abilities to design PISA-like mathematics task regarding the authenticity and language structure (Zulkardi & Kohar, 2018), and most of the teachers could only provide some materials and exercises on routine problems at the low level (Putri and Zulkardi, 2018). Some potential effort has been carried out by providing learning resources such as developing mathematics problems with the PISA framework (Kohar and Zulkardi, 2018; Stacey, 2015).

Indonesian students have poor performance in PISA since 2000, which has gained much attention from practitioners and policymakers to reform the 2013 curriculum. MOEC (2019) established PISA as an international standard for education in Indonesia and instructed future learning should conform to the PISA standard. Additionally, a concrete step was bravely taken by the Indonesian government by issuing a breakthrough wrapped in four educational policy programs dubbed freedom of learning or "*Merdeka Belajar*" in Bahasa, which refers to good instructional practices the international level such as PISA (MOEC, 2019). The boldest one is the implementation of a national examination in 2021 will be changed to the Assessment of Minimum Competency (AMC), which consists of the ability of languages (literacy), the ability of mathematics (numeracy) and the strengthening of character education (MOEC, 2019). In line with mathematical PISA framework 2021 (2018), the term "Numeracy" is defined as fundamental proficiency that provides students to formulate, employ, and interpret mathematics in a variety of contexts in real-life problems.

In particular, the curriculum 2013 also stresses mathematics literacy tasks that force students to use their higher-order thinking skills (HOTs) and collaborative learning (Putri & Zulkardi, 2019). In the school, teachers are working and learning together using Lesson Study for Learning Community (LSLC) (Putri & Zulkardi, 2020; Octarina, Putri, Nurjannah, 2019; Zaskiyah, 2019). In mathematics classrooms, two kinds of problems that are given to students, namely easy task or sharing task and complicated task or jumping task (Putri & Zulkardi, 2020). Putri and Zulkardi (2019) stated that share tasks were used at the beginning of mathematics lessons and usually provided problems at the bottom of level 3 while jumping task was the central part of the teaching that commonly used HOTs level problems in learning. These tasks can be used in problem-based learning using LSLC system to enhance students' higher-order thinking skills (Putri, 2018). In line with (Sato & Sato, 2003; Sato, 2014), who stated that learning by emphasizing problems could develop students' higher-order thinking skills.

Thus, the implementation of both tasks must immediately familiarize the class to meet the 2013 curriculum demands. Previous researches have produced both tasks related to PISA-like mathematics with a focus on examining local context (Dasarprawira, Zulkardi & Susanti, 2019), sport branches of Asian Games 2018 (Putri & Zulkardi, 2020; Nizar, Putri & Zulkardi, 2018; Permatasari, Putri & Zulkardi, 2018), concerning on level (Ahyan, Zulkardi & Darmawijoyo, 2014) and attracting students to learn and enhance mathematical literacy skills (Efriani, Putri & Hapizah, 2019; Jannah, Putri, & Zulkardi, 2019). However, many teachers have not been accustomed to completing and developing

both tasks sharing and jumping using the PISA framework in their respective schools. Therefore, 27 schools were engaged in training activities to create and solve mathematical problems like the PISA task used as sharing and jumping tasks. This paper aims to report the process of professional development of mathematics teachers in Palembang in developing a set of valid, practical, and have the potential effect of both sharing task and jumping tasks using the PISA framework.

METHODS

This research used the design research method with the type of development studies as the main framework, which consisted of preliminary and formative evaluation (Bakker, 2018; Zulkardi, 2002). The formative assessment was done by emphasizing the prototyping process, including self-evaluation, expert review, one to one, small group, and field test. This research involved the teachers from the representatives of 27 secondary schools in Palembang.

The main activities undertaken in the preliminary:(1) constructing knowledge through training activities about introducing what and why PISA item 2000-2012 and the role of sharing and jumping task in the classroom; (2) examining the current curriculum and developing the initial tasks both sharing and jumping using PISA framework on Plano paper.

At the self-evaluation phase, the teachers analyzed the curriculum by determining a basic competency and producing indicators and learning objectives of the developed tasks. The validation process was carried out through focus group discussion by giving the initial tasks to experts and one to one at once. At the experts' review phase, a panel discussion (item paneling) was performed by involving the lectures and doctoral students of mathematics education of Universitas Sriwijaya. In line with Turner (2000), item paneling was an essential step in developing high-quality test items. Along with it, one to one was attended by the teachers in each group. This phase focuses on the clarity and readability of the developed tasks from the teachers' comments in a group. The developed tasks were categorized valid after revising the prototype based on feedback and suggestions from experts and one to one.

The small group phase was conducted by involving the teachers from another group. Then, it piloted to the teachers (participants of the training activities) to determine the potential effects of mathematics literacy.

Data were collected by using documentation, observation, focus group discussion, and interviews. Photos, videos, and field notes are also used as data sources. Then, to describe the result of the development process, the collected data were analyzed descriptively.

RESULTS AND DISCUSSION

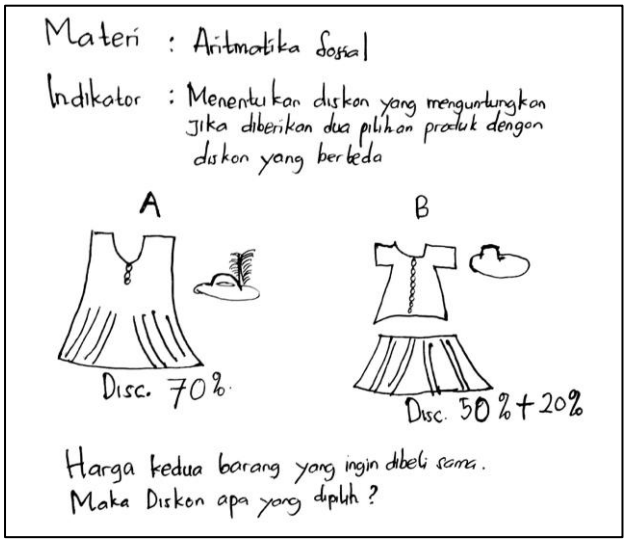
This study had produced a set of valid, practical, and have potential effects of both sharing task and jumping tasks using the PISA framework. At the preliminary stage, teachers were introduced to what and why PISA items 2000-2012. Then, it continued by the role of sharing and jumping tasks in the classroom. The participants were grouped regarding the subjects with a maximum of 4 teachers included mathematics, science, social, language, and teachers from primary and kindergarten schools. The researchers observed and analyzed during the process of teachers' training in developing JUMPISA i.e., teachers' understanding of PISA-like problems, teachers' proficiency in solving the PISA-like problem after the practice, and guide them to the further expected knowledge.

Figure 1. The process of training activities

Figure 1 described the opening and the process of the workshop on developing JUMPISA. The participant's sitting position was conditioned to form the letter U (horseshoe) so that the teachers could explain how the sitting place should be done to the students at the beginning of the learning activity. Also, the U-shaped seating arrangement is used as one way to see which learners will be focused on attention on existing learning. In line with (Sato, 2014) stated that class structuring must resemble a seminar model (the letter U as figure 1) to make learners active in learning and continued with collaborative learning in a group.

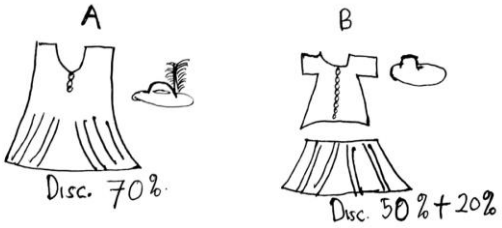
Each group was given about 1,5 – 2 hours to analyze the curriculum, determine a basic competency by generating indicators and learning objectives of developed tasks using the PISA framework. Then, the teachers in a group were asked to develop the initiative of sharing and jumping tasks on Plano paper.

Sharing Task



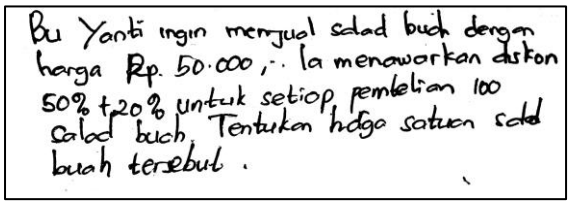
Translation

Material : Social Arithmetic
Indicator : Determine a favorable discount price when given two items with different discounts.



The price of both items is the same. Which discount do you choose?

Jumping Task



Translation

Mrs. Yanti wants to sell fruit salad at a price of 50,000. To attract the consumers' attention, she gives a $50\% + 20\%$ discount for purchasing 100 fruit salads. What is the price of 1 fruit salad?

Figure 2. Sharing and jumping task was designed by the teachers

Figure 2 showed the representative of the developed tasks by mathematics teachers' group: the developed sharing task and jumping task using quantity content. On the sharing task, the question required students to determine the largest discount of both items. Students are required to determine the price of an item using the concept of social arithmetic on the jumping task.

Expert reviews and one-to-one phases were carried out at once. Expert reviews were conducted by focus group discussion by asking each group to present the sharing task and jumping task that they developed. The result of the groups' presentation was directly given suggestions and comments by both experts and doctoral students of mathematics education of Universitas Sriwijaya. The clarity and readability based on language and figural display were assessed by each member of the group. The suggestions and comments were taken to consider to revise both tasks that will be used for following up in a small group phase. The process of changing developed tasks can be seen in table 1.

Table 1. The process of changing the developed tasks

Validations	Comments/Suggestions	Revision
	Sharing Task	
Experts/Validators	- The items sold must be the same. - Change the sentence of the question, "which discount do you choose" to be, "which stores are profitable for Sarah"?	The items were changed The question sentence has been adjusted with suggestions
Teachers	- The given situation should be different shop and discount	The situation given was changed
	Jumping Task	
Experts/Validators	- The developed task is not categorized jumping task - The context given is camouflage and the discount given is unreasonable	Improving the difficulty level The problem was changed to an image problem and the discount provided was adjusted
Teachers	- Change to image problem instead of the word problem	The problem was changed to the image problem

Experts and teachers' comments and suggestions were decided to revise the developed tasks (Zulkardi, 2002). Based on the content, the developed tasks were included in social arithmetic material, which was studied in 7^{th} grade in the 2013 curriculum. In terms of construct, the word problem transformed into an image-problem to avoid the camouflage context that is difficult to imagine. In addition, the difficulty level on the jumping task is also improved. This is because the jumping task is a kind of problem that can only be done by less than 30% of students (Sato, 2014). Then, in terms of language, the question sentence is changed so that it does not contain a variety of meanings.

The revised tasks based on focus group discussion were then tested on small groups that involved other groups in completing the tasks. At a small group phase, the other groups were involved, which consisted of 4 teachers to work on it individually to see practicality the developed tasks. The result indicated that the developed tasks could be easily understood by the teachers and well solved. There is no change in this phase but a little error of type that needs to be corrected. According to Zulkardi (2006), the practicality reflected from the developed problem could be understood, easy to use, administrated, and interpreted well by students in the small group phase.

Sharing Task

Jumping Task

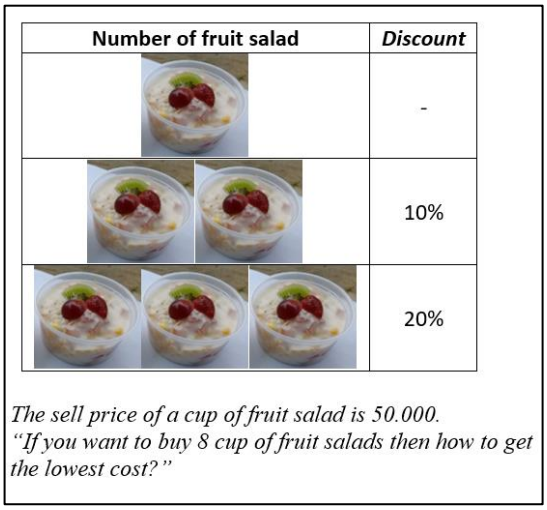
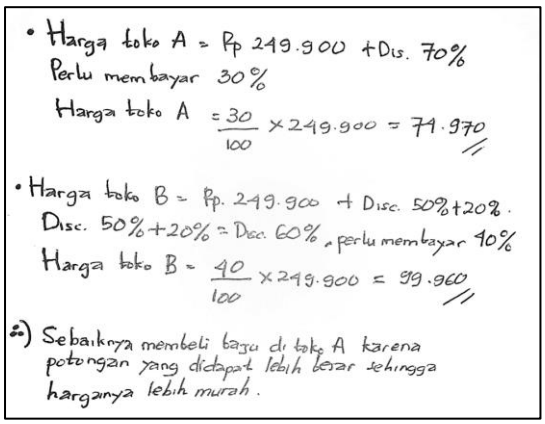
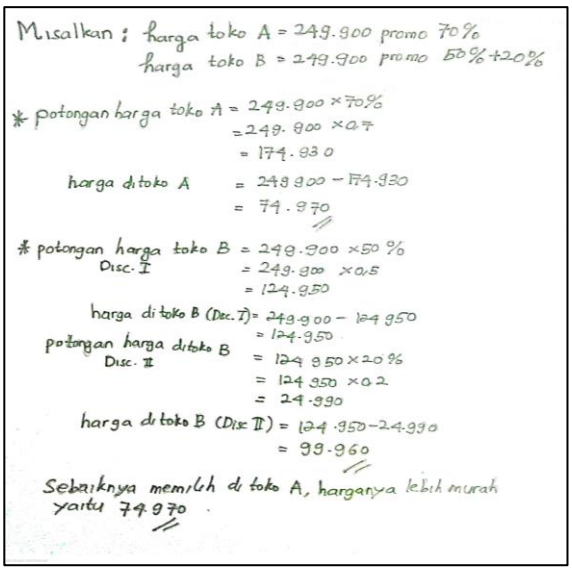


Figure 3. Sharing and jumping task after revision

Then, it piloted to field test, which involved the teachers exploring the potential effects in detail on mathematics literacy. From the teachers' solutions, almost all teachers could solve both tasks sharing and jumping by using a different point of view to respond to the developed tasks given.



(a)



(b)

Translation

Price at shop A: Rp 249.900 + Disc. 70%
Money must be paid: 30%
Price at shop A: $\frac{30}{100}$x249.900 = 74.790

Price at shop B: Rp 249.900 + Disc. 50%+20%
Disc. 50%+20%=Disc. 60%
Money must be paid: 40%
Price at shop B: $\frac{40}{100}$x249.900 = 99.960

Translation

Suppose: The price at shop A = 249.900 70% off
The price at shop B = 249.900 50%+20% off
Disc. At shop A = 249.900 x 70%
= 249.900 x 0.7
= 174.930
The price at shop A after getting Disc. 70%
= 249.900 − 174.930
= 74.970

Preferably buy at shop A, because it gets a bigger discount than at shop B, so the price is lower.

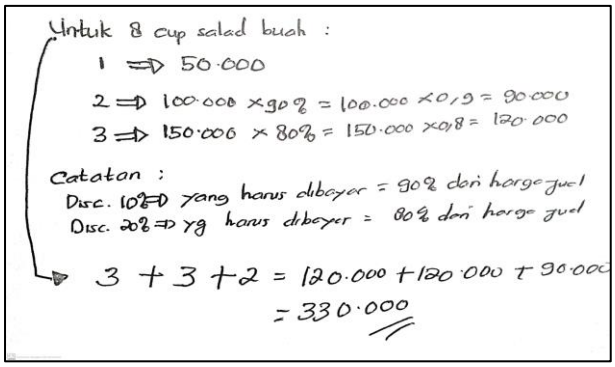
Disc.I At shop B = 249.900 x 50%
= 249.900 x 0.5
= 124.950
The price at shop A after getting Disc. 50%
= 249.900 − 124.950
= 124.950
Disc.II At shop B = 124.950 x 20%
= 124.950 x 0.2
= 24.990
The price at shop A after getting Disc. 50%
= 124.950 − 24.990
= 99.960

The price at shop A is lower than shop B which is 74.970

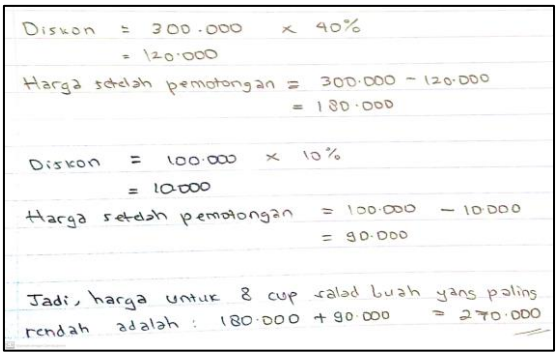
(a) (b)

Figure 4. Teachers' solution on sharing task

Based on figure 4 (a), the student understands the concept of discount with a reasoned process in determining the price must be paid., i.e., when getting a 70% discount means they only have to pay 30%. So, the money must be paid by looking for a value of 30% of the selling price. In addition, students understand that 50% + 20% is equal to get 60% off. The money must be paid by looking for a value of 40% of the selling price. Unlike the solution in figure 4 (b), although, in the end, it has the same result, the steps given are more systematic, and its process is clear. Stacey (2014) pointed out that all logical method can be used by students in solving the given problem given full value. It is also expressed by (Permatasari, Putri & Zulkardi, 2018; Efriani, Putri & Hapizah, 2019) that students with good reasoning could answer the problem given completely and correctly. Meanwhile, the analysis result of the jumping task can be seen in figure 5.



(a)



(b)

Translation

For 8 cups of fruit salad:
1 → 50.000
2 → 100.000 x 90% = 100.000 x 0,9 = 90.000
3 → 150.000 x 80% = 150.000 x 0,8 = 330.000

Translation

Discount = 300.000 x 40 %
= 120.000
The price after getting Disc.
= 300.000 − 120.000
= 180.000

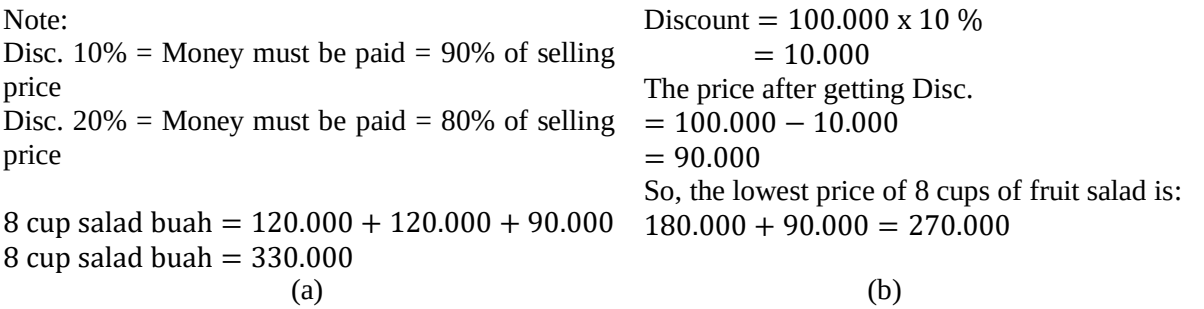


Figure 5. Teachers' solution on jumping task

Figure 5 shows teachers' solutions to jumping tasks. In figure 5 (a), teachers tend to answer the question by calculating the selling price of the fruit salad package offered. For the selling price, suppose 100%, so the amount after the discount is calculated by finding the difference price (in the form of percentages) times to the selling price. To determine the lowest price, (a) tends to take two packages i.e., buy 3 with a 120,000 and 1 package i.e., buy 2 with a rate of 90,000. Unlike the solution made by (b), they tend to take the same bags as (a), but there is an error in calculating the selling price after getting the discount. It is because (b) figured the two packages i.e., buy 3 with the amount of 120.000 with double discount, which is 40%. The jumping task contains problems with a high level of difficulty, allowing many students to make a mistake in solving them. As Sato explained (2014), the Jumping task is a kind of problem that can only be done by less than 50% of students. Several steps are missing in the solution given to the problem but with the correct calculation process in completing the given task. In line with Yansen, Putri, Zulkardi & Fatimmah (2019), the students used different strategies by directly providing the logical answer without having to perform the calculation process.

After the field test, the researchers, along with the teachers doing a reflection about the training activities. This stage aims to discover the advantages and disadvantages of the training activities to develop JUMPISA that has been carried out. The teachers started the discussion by conveying their impressions, experiences, constraints, and opinion regarding what they have learned (Nuraida & Putri, 2018). Based on the results of reflection, it can be known most of the teachers were pleased to participate in the training activities of the development of JUMPISA. The teachers gained a lot of new insights toward mathematics problems with the characteristics of JUMPISA, how to design both task sharing and jumping tasks using the PISA framework, and find a variety of exciting contexts to use in the JUMPISA problem. Also, the teachers were motivated to create and implement both tasks sharing and jumping in the classroom. Besides, the teachers need further assistance so that the training activities can be developed regularly and involve the teachers from all levels (kindergarten to high school).

CONCLUSION

The task design training program using examples of PISA-like can support teachers in developing their tasks, both sharing and jumping. The development process during training activities has produced both tasks which categorize valid, practical, and had potential effects on mathematics literacy. The validity was founded in terms of content, construct, and language. The practicality can be seen from the small group phase, which is the developed tasks can be easily understood by the teachers and well solved even with different strategies. The potential effects can be seen based on teachers' solutions, including reasoning and arguments, and devising strategies for problem-solving. In sum, the training program using PISA-like examples provided teachers' experiences to design both tasks sharing and jumping using the PISA framework in the classroom.

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