

# Artikel Atlantis Ely Anggita

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# Designing Creative Problem-Solving Based Worksheet for Specialization

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## ABSTRACT

This was a design research that aimed to produce creative problem solving based worksheet that can be used to practice specialization. The subjects of this study were students of class IX SMP Negeri 1 Muara Enim. This research consisted of five stages, namely: preliminary design, focus group discussions, trials, observations and interviews, and retrospective analysis. The instruments used were students' worksheet, observation, and interview. Data analysis used was descriptive qualitative methods. Based on the results of data analysis, it was found out that the developed subject worksheet was categorized as quite good, but it needed revision on the problems presented. The problem presented did not describe problem solving and the creativity of the subject is not visible while solving it. For example, in problem 3, many subjects used calculators to solve it. Neither subject has used algebraic concepts to solve it.

**Keywords:** Designing, Creative problem solving, Worksheet, Specialization.

## 1. INTRODUCTION

Abstraction is an activity that reorganizes previous mathematical constructs [1] into new mathematical structures [2] that are constructed after relationships are built [3]. Abstraction is an important skill in mathematics at the secondary school level [4][5]. By having the ability of mathematical abstraction, the subject can understand and find the relationship between basic mathematical concepts [6][7] through abstract situations [8]. Furthermore, subjects begin to be able to eliminate their dependence on real objects in solving problems [9]. This shows that having abstraction ability can help the subject in describing abstract situations [10].

Abstraction is influenced by four factors, they are pattern discovery, specialization, conjecture, and generalization [11][12]. Specialization is one of the most important aspects of abstraction. Specialization is defined as the activity of seeing something as an example of 'something'. Specialization is a way of solving problems by looking at specific cases and looking at specific examples [13][14][15][16]. Specialization arises when the subject can draw

connections between the information provided to solve a problem [17].

However, in fact the subject still finds difficulties in abstract thinking, especially in the specialization aspect. One of the materials that is difficult for the subject is exponent. The reason is because the subject does not master mathematical concepts, the subject does not have direct experience with the object and some subjects find it difficult to describe the relationship between concepts so that they cannot apply the concept to the appropriate context [18]. In addition, the problem that often arises related to specialization is that the subject is often confused about the meaning of the question, is unable to reflect on previous activities and knowledge in new situations so that he is unable to solve problems [5].

Based on previous research, it was concluded that one of the lessons that has the potential to practice this aspect of specialization is Creative Problem Solving (CPS). CPS is very closely related to problem solving because this learning invites subjects to use creativity and independence when solving problems [19]. In addition, Adelia (2019) states that after learning through the CPS model, it was found that the aspect of mathematical abstraction that most often appears in the

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subject is specialization [20]. In CPS there are stages of Visioning or Objective-Finding and Fact-Finding. These two stages are defined as activities to understand the meaning of the problem, and then ask the subject to summarize information and detail the facts that are considered related to solving the problem [21]. This is in line with specialization, the condition for the emergence of specialization is when the subject can draw connections between the information obtained to solve problems [10]. Based on the above problems, this study aimed to design a CPS-based subject worksheet that can be used to train mathematical specializations.

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## 2. METHOD

### 2.1. Research Procedure

This is design research, since it aims to produce CPS-based worksheets that can be used to practice mathematical specialization of the subject. In this study there were five stages, namely preliminary design, focus group discussion (FGD), Trials (Test), Interview, and retrospective analysis [22]. At the preliminary design stage, researchers seek and tried to understand the study of theories about specialization, creative problem-solving and several problem-solving questions for exponent material, and then put it in the form of worksheet.

### 2.2. Subject

The subjects of this study were Grade IX students of SMP Negeri 1 Muara Enim. The subjects who were involved in this study was 3 students. The subject selection was based on the recommendation of the supervising teacher. The characteristics of the students in Grade IX were categorized as heterogeneous consisting of a mixture of high-ability, medium-ability, and low-ability students.

### 2.3. Instrument

Data collection techniques used were worksheet, observation, and interviews. The worksheet contained 3 problems about exponents. The problem was followed by questions that train the subject in specialization aspects. Other instruments were observation sheets and

interview sheets. The observation sheet was used to observe the characteristics of the subject's answer, while the interview sheet was used to extract information from the subject regarding the answers he had given. The interviews used a semi-structured type, it was meant so that the questions can be developed as needed.

### 2.4. Data Analysis

The data analysis technique was divided into two parts, namely data analysis of worksheets and data analysis of interview results. The data of the worksheets were analyzed qualitatively descriptive by telling what was found during the study. In this study, the analysis of interview data began with creating transcription of conversations between teachers and students. Furthermore, the result of the transcript was reduced and selected whichever information was categorized as important data. The results of this reduction were presented in the form of a description to be juxtaposed with the test result data.

## 3. RESULT AND DISCUSSION

### 3.1. Result

The results of this study were presented in a descriptive qualitative manner based on research procedures which consisted of Preliminary Design, Focus Group Discussion, Trial, Observation and Interview, Retrospective Analysis.

#### 3.1.1. Research Procedure

At the preliminary design stage, researchers seek and understood the study of theories about specialization, creative problem solving and exponent material. Based on the results of theoretical studies and referring to the curriculum, it was found that the worksheet was only focused on problems that were categorized as problem solving. Due to the limited learning time, the subject worksheet at each meeting only consisted of three problems. In addition, from the results of theoretical studies on creative problem solving, it was found that CPS consists of five stages. At these stages, leading questions were made is leading question aimed to practice specialization. Based on the results of the theoretical study of specialization, it was found that specialization was the activity of seeing something as an example of "something". Specialization can also be defined as a way to solve problems by looking at specific cases and seeing specific examples [13][14][15][16]. Specialization is seen when the subject can draw connections between the information provided to solve problems [17].

Based on the above theory, then it was written in the form of a worksheet. The worksheet that was designed also contained an identity component, learning

objectives and work instructions. Here are the results of the subject worksheet design:

<p><b>Problem 1</b></p> <p>Determine the sequence of number <math>2^{55}</math>, <math>4^{22}</math>, and <math>3^{33}</math> from the highest to the lowest number.</p>
<p><b>Problem 2</b></p> <p>Determine the last digit of <math>4^{24}</math>.</p>
<p><b>Problem 3</b></p> <p>Between the following two exponents, i.e. <math>19^{20}</math> and <math>20^{19}</math>. Determine which number is greater..</p>

Figure 1. Problems presented on the worksheet

In addition, each problem was also followed by several leading questions. Here are the leading questions that are presented in each problem.

<p><b>Questions in Each Problem</b></p> <ul style="list-style-type: none"> <li>• <b>Visioning or Objective-Finding:</b> what is the purpose of the problem above?</li> <li>• <b>Fact-Finding:</b> What information do you get from this problem?</li> </ul>
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<ul style="list-style-type: none"> <li>• <b>Specialization:</b> Have you considered trying an example? What happened to the experiment?</li> <li>• <b>Problem Finding:</b> Can you write in your own words the purpose of the problem given?</li> <li>• <b>Idea Finding:</b> Can you come up with ideas or rules to help solve the problem? Explain your opinion!</li> <li>• <b>Solution Finding:</b> Write down the answer you predicted along with the steps!</li> <li>• <b>Acceptance Finding:</b> Show whether your answer is correct!</li> </ul>
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Figure 2. Leading questions in each problem

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3.1.2. Focus Group Discussion

Focus group discussions were conducted by the research team, teachers, and two other lecturers from Education Study Program, Sriwijaya University. This FGD produced several notes that were categorized into 5 aspects, namely, problem 1, problem 2, problem 3, display, and language.

Table 1. The results of focus group discussion

Aspect	Results of FGD
Problem 1	<ul style="list-style-type: none"> <li>• (Prediction of answer), Specialization part, (it is found that the exponents are a multiple of 11) It is more precise to be in idea finding, it is better to use examples of small numbers</li> </ul>
Problem 2	<ul style="list-style-type: none"> <li>• Should be reviewed</li> </ul>
Problem 3	<ul style="list-style-type: none"> <li>• <b>Acceptance Finding</b>, Isn't it better if you add a sentence that directs students to use the calculator? (Prediction of answer), It is better to add examples starting from 1 and 2, thus you can see the conditions of <math>a \geq 3</math></li> <li>• (Discussion), pay attention to the conclusions written. Is that correct that "<math>a^b &gt; b^a</math>, if <math>a &lt; b</math>."</li> </ul>
Display	<ul style="list-style-type: none"> <li>• It is better if the design is made to be more attractive</li> <li>• Add the processing time for LKPD</li> <li>• Revise the title, bigger and bolder the font size.</li> <li>• Increase the line spacing on basic competency column.</li> </ul>
Language	<ul style="list-style-type: none"> <li>• Revise the instructions of CPS learning</li> <li>• Fix the typos</li> </ul>

3.1.3. Trials

Based on the teacher's recommendation, the trial was carried out on ZMM, KMI, and TN. The three subjects already represent three levels of subject ability, namely: high, medium, and low. After looking at the subject's answer and comparing it with the predictions that have been made, then an interview was carried out to explore

information and reasons why the subject answers as they had written.

**Problem 1**

Based on the results of testing on research subjects, information was obtained that the ZMM subject saw that the powers of the three numbers had the same pattern, namely repeating numbers. Therefore, ZMM answered that the three numbers in the powers could be divided by an equal number, i.e. 11 by using concept of



$a^p = (a^n)^m$  as illustrated on the following answer written by ZMM. Furthermore, to find and sort the numbers from lowest to highest, ZMM used the concept of  $a^p = (a^n)^m$ , although there was an error in the answer, the idea used by ZMM seems quite rational. ZMM only looked at which number was smallest or largest by comparing  $a^n$ . ZMM settlement is shown in the following figure.

Figure 3. ZMM's answer on problem 1

In contrast to the ZMM subject, to determine which number was the smallest and largest TN subject simplified the form of the problem. According to the TN subject, because the powers of the three numbers were repeated, by taking only one number in the exponent, it can be seen which was the smallest number and which was the largest number. Even though it looked rational, the ideas used violated the concept and cannot be generally accepted, as seen in the following picture.

Figure 4. The TN idea appeared but it could not be used

Furthermore, by using the concept of  $a^p = (a^n)^m$  TN can solve the problem. The following is a continuation of the answer from TN. Subject KMI has the same mindset as TN in exploring ideas that have been studied. KMI used more simple numbers. However, she realized that the concept was illogical and imprecise, therefore KMI did not use this concept to solve the problem. This is also reflected in the results of interviews conducted with KMI. The following is an excerpt from an interview conducted with KMI.

KMI	:	Yes, actually, I just write down the numbers that come to my mind, miss. That's what appeared, I'm also a little confused about how to work on it
A	:	Is the conclusion drawn unable to help solving the problem?
KMI	:	Yes, miss.

Subject KMI used a calculator to calculate the value of  $4^{22}$ ,  $3^{33}$ ,  $2^{55}$ . From the results of the calculator, the

resolution for problem number 2 can be obtained. The following is the final solution of subject KMI.

Figure 5. The resolution for problem 2

**Problem 2**

To see whether the leading questions presented in the subject worksheet can help the subject find a solution, the three research subjects were given another problem. The second problem was the application of the exponential concept. Problem 2 required the subject to find the last digit of an exponent.

Based on the results of the trial, it was found that ZMM realized that to solve problem 2 it could use simple patterns and concepts of exponents. The pattern that ZMM got was that the last digit repeats itself. However, ZMM made a little mistake in adding the answer and creating another pattern by looking at the remainder of the power division of the number by 4. This last pattern at first glance looked rational but was not quite right. Here is ZMM's answer to problem 2.

Figure 6. The ZMM's answer to problem 2

Unlike the ZMM, Subject TN gave a more rational and logical answer. In solving problem 2, TN only used the basic concept of exponents that if any  $a^m = a \times a \times a \dots a$  (as much as  $m$ ). In addition, TN also uses the concept of the last digit. However, TN found there was a separate pattern in solving this problem, namely the last digit of the number 4 to the integer power produced the last digit of the number 4 or number 6. TN found the last digit of  $4^m$  would be 4 if  $m$  was an odd number, and would be 6 if  $m$  is an even number. This is illustrated by TN's answer:

Berikut penyelesaiannya:  
 $4^1 = 4$   
 $4^2 = 16$   
 $4^3 = 64$   
 $4^4 = 256$

Maka disimpulkan bisa pangkat dari bilangan itu ganti maca digit terakhirnya = 4, bisa pangkat dari bilangan itu genap maca digit terakhir = 6

Maka  $4 \rightarrow 4^{24}$  → bilangan pangkatnya = genap  
 Jadi digit terakhir dari  $4^{24} \rightarrow 6$

Figure 7. The TN aswer

Just like in answering the first problem, KMI still used a calculator to solve problem 2. KMI thought that to solve the problem only one concept was used, namely the basic concept of exponents. The following is KMI's answer.

Jawaban dari permasalahan adalah,  
 $4^{24} = 2^{48}$  (disederhanakan)  
 $2^{48} = 281474976710656$ .  
 Jadi digit terakhir dan bilangan  $2^{48} / 4^{24}$  adalah 6.  
 atau bisa juga dengan metode 2, 4, 8, 6.  
 contoh:  
 $4^0 = 6$      $4^5 = 2$   
 $4^1 = 2$      $4^6 = 4$   
 $4^2 = 4$      $4^7 = 8$   
 $4^3 = 8$      $4^8 = 6$   
 $4^4 = 6$

Figure 8. KMI's answer.

**Problem 3**

In this study, the three subjects were also given a third problem. The third problem looks simple because it only compares two numbers i.e.  $19^{20}$  and  $20^{19}$ . Furthermore, the subject was asked to determine which number had a greater value. In resolving this problem ZMM and KMI did not come up with any other ideas. They only used the basic concept of exponents. Then found the solution by using a calculator. Despite using the calculator, ZMM still made mistakes in calculating it and resulted in the wrong conclusions being drawn. Here is ZMM's answer.

$19^{20} = (19^{10})^2 = 19 \times 19 \times 19 \times 19 \times 19 \times 19 \times 19 \times 19 \times 19 \times 19$   
 $19 \times 19 \times 19 \times 19 \times 19 \times 19 \times 19 \times 19 \times 19 \times 19$   
 $19 \times 19 = 379889735$

$20^{19} = (20^9)^2 = 20 \times 20 \times 20 \times 20 \times 20 \times 20 \times 20 \times 20 \times 20$   
 $20 \times 20 \times 20 \times 20 \times 20 \times 20 \times 20 \times 20 \times 20$   
 $= 524288000$

Maka, nilai yang paling besar adalah  $20^{19}$

Figure 9. The ZMM's answer.

Different results were obtained by Subject TN. TN used a simple example, he used number  $5^3$  and  $3^5$ . From these results, the TN tested it on numbers  $19^{20}$  and  $20^{19}$ . And to confirm these results TN used a calculator. From the results of calculations using a calculator, TN concluded that the number to the greatest power was the largest number. Here is TN's answer to problem 3.

Saya mencoba contoh berikut:  
 $5^3$  dan  $3^5$  (mana bilangan terbesar)  
 $5^3 \rightarrow 125$   
 $3^5 \rightarrow 243$

Maka bilangan berpangkat yang paling besar adalah  $3^5$

... juga kamu percoba serta tuliskan langkah-langkahnya!  
 $19^{20} \rightarrow 12.262.132.512.602$   
 $20^{19} \rightarrow 10.752.000.000.000$

Maka dapat disimpulkan bahwa  
 $\rightarrow 19^{20} > 20^{19}$   
 $=$

Figure 10. TN's answer to problem 3.

3.1.4. Retrospective Analysis

The final stage was retrospective analysis. At this stage all the findings in the study were analyzed and then used to improve the subject's worksheet. From the results of the focus group discussion and trial results, it was found that in general the worksheets that were designed were in the good category. The leading questions given can guide the subject to find a solution. However, from the test results, it was found that there were still subjects who used calculators. This was because the problems presented were too simple. Therefore, it was necessary to do a little revision of the worksheet by increasing the difficulty level.

3.2. Discussion

Specialization is one of the aspects of mathematical thinking [23]. It is important for student to have specialization ability in problem-solving [24], [25]. The difficulty in specialization shown in problem 1, 2 and 3. From the research results, there are still subject who are unable to linking the information from the trial to resolve the problem. On problem 1, one of the subjects has tried an example but the way she does it is incomplete, so the answer seems quite rational. Even

though it looked rational, the ideas used violated the concept and cannot be generally accepted. While others have tried the example and linked the information obtained from the example to resolve the problem but the idea cannot be used to resolve the problem. On problem 2, students can understand the problem given and try examples and connect information that can solve the problem but a subject made a little mistake in adding the answer and creating another pattern by looking at the remainder of the power division of the number by 4. This last pattern at first glance looked rational but was not quite right. On problem 3, the subjects can understand the given problem. There is a subject who tries an example and concludes that the larger number is the number that has the highest rank the subject confirms using the calculator as well as others.

In general, it can be concluded that the subjects understood the problem but still found some subjects who have not been able to connect the information obtained from the example they tried especially [26].

## 5. CONCLUSION

Based on the results of data analysis, it was concluded that the subject worksheet developed was categorized as good enough, but it needed revision on the problems presented. The problem presented did not describe problem solving and the creativity of the subject was not seen when solving it. For example, in problem 3, the majority of subjects used calculators to solve it. Neither subject has used algebraic concepts to solve it.

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## REFERENCES

- [1] M. Mitchelmore, P. White, Abstraction in mathematics and mathematics learning, *International Group for the Psychology of Mathematics Education*, 2004.
- [2] H.B. Sinaceur, Facets and levels of mathematical abstraction. *Philosophia Scientiæ. Travaux d'histoire et de philosophie des sciences*, vol. 18 no.1 2014, pp. 81-112.
- [3] R. Hershkowitz, B.B. Schwarz, T. Dreyfus, Abstraction in context: Epistemic actions. *Journal for Research in Mathematics Education*, pp. 195-222, 2001.
- [4] Djasuli, C. Sa'dijah, I.N. Parta, T.D. Chandra, Students' reflective abstraction in solving number sequence problems, *International Electronic Journal of Mathematics Education*, vol. 12 no.3, 2017, pp. 621-632.
- [5] A.L. Nisa, Analisis kemampuan abstraksi matematis siswa dalam menyelesaikan soal pada materi segiempat kelas VII SMP, *Jurnal Pendidikan Matematika (JPM)*, vol. 4 no. 1, 2019, pp. 01-08.
- [6] M. Mitchelmore, P. White, Abstraction in mathematics and mathematics learning, *International Group for the Psychology of Mathematics Education*, 2004.
- [7] P.L. Ferrari, Abstraction in mathematics. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, 358(1435), 2003, pp. 1225-1230.
- [8] N. Mandasari, Elaborasi kognitif dalam proses abstraksi konsep matematika, in: *Prosiding Seminar Nasional Program Pascasarjana Universitas PGRI Palembang*. vol. 5 no. 05, 2018.
- [9] A.E. Yunita, A. E. Meningkatkan kemampuan abstraksi matematis siswa dengan menerapkan pembelajaran blended learning berbasis chamilo: Penelitian kuasi eksperimen terhadap siswa kelas XI IPA 1 SMA Al-Ma'soem (Doctoral dissertation, UIN Sunan Gunung Djati Bandung), 2017.
- [10] J. Bennedsen, M.E. Caspersen, Abstraction ability as an indicator of success for learning object-oriented programming?. *ACM Sigcse Bulletin*, vol. 38 no. 2, 2006, pp. 39-43.
- [11] I.F. Iswari, E. Susanti, Hapizah, Meryansumayeka, A. Turidho, Design of problem-solving questions to measure mathematical thinking type abstraction. In *Journal of Physics: Conference Series*. vol. 1318 no.1, 2019, pp. 012104.
- [12] J.T. Mulligan, M.C. Mitchelmore, Early awareness of mathematical pattern and structure. In *Reconceptualizing early mathematics learning* Springer, Dordrecht, 2013.

- [13] J. Mason, L. Burton, K. Stacey, *Thinking Mathematically*. Pearson Higher Ed, 2011.
- [14] K. Stacey, What is mathematical thinking and why is it important, 2006.
- [15] Z. Karadag, *Analyzing students' mathematical thinking in technology-supported environments* (Doctoral dissertation, University of Toronto), 2009.
- [16] V. Adelia, E. Susanti, N. Sari, R.H. Simarmata, Abstraction ability in number patterns problems. *In Journal of Physics: Conference Series*. vol. 1480 no. 2020, pp. 012049.
- [17] Susanti, Hapizah, Meryansumayeka, Irenika, Mathematical thinking of 13 years old students through problem-solving. *In Journal of Physics: Conference Series*, vol. 1318 no. 1, 2019, pp. 012103.
- [18] I. Nurhikmayati, Kesulitan berpikir abstrak matematika siswa dalam pembelajaran problem posing berkelompok. *Kalamatika, Jurnal Pendidikan Matematika*, vol. 2 no.2, 2017, pp. 159-176.
- [19] A.D. Sari, S.H. Noer, Kemampuan pemecahan masalah matematis dengan model creative problem solving (cps) dalam pembelajaran matematika, in *Prosiding Seminar Nasional Matematika dan Pendidikan Matematika* vol. 1 no. 1, 2017, pp. 245-252.
- [20] H. Kim, S. Cho, D. Ahn, Development of mathematical creative problem-solving ability test for identification of the gifted in math. *Gifted Education International*, vol. 18 no. 2 2004, pp. 164-174.
- [21] M.F. Giangreco, C.J. Cloninger, R. Dennis, S. Edelman, *Problem-Solving methods to facilitate inclusive education. creativity and collaborative learning: a practical guide to empowering students and teachers*, 1994.
- [22] A. Nurzalena, E. Susanti, Hapizah, Meryansumayeka, A. Miswanto, Design of problem-solving questions for measuring mathematical thinking type mathematization. *In Journal of Physics: Conference Series*, vol. 1318 no.1, 2019, pp. 012106.
- [23] S. Breen, A. O'Shea, The use of mathematical tasks to develop mathematical thinking skills in undergraduate calculus courses—a pilot study. *proceedings of the british society for research into learning mathematics*, vol. 31 no. 1, 2011, pp. 43-48.
- [24] J. Mason, S. Johnston-Wilder, *Designing and using mathematical tasks*. Tarquin Publications, 2006.
- [25] S. Breen, A. O'Shea, Mathematical thinking and task design, *Irish Mathematical Society Bulletin*, (66) 2010, pp. 39-49.
- [26] M. Doorman, P. Drijvers, T. Dekker, van den Heuvel-Panhuizen, M., de Lange, J., M. Wijers, Problem solving as a challenge for mathematics education in The Netherlands. *ZDM*, 39 (5-6) 2007, pp. 405-418.



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